**3GPP TSG-RAN WG1 Meeting #102-eR1-2007307**

**e-Meeting, August 17th – 28th, 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  | **36.213** | **CR** | **1355** | **rev** | **-** | **Current version:** | **16.2.0** |  |
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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:***  | Number of HARQ processes in multi-TB scheduling in CE mode B in TDD in LTE-MTC |
|  |  |
| ***Source to WG:*** | Moderator (Ericsson) |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | LTE\_eMTC5-Core |  | ***Date:*** | 2020-08-26 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-16 |
|  | *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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | RAN1#95 agreed that for UL multi-TB scheduling for CE mode B, the maximum number of scheduled transport blocks with one single DCI is 4, but this agreement is not captured in the specification for the TDD case.This issue was discussed in RAN1 email discussion [102-e-LTE-eMTC5-04] captured as Issue #1 in [R1-2007305](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Docs/R1-2007305.zip). |
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| ***Summary of change:*** | Clarify that up to 4 HARQ processes is supported for multi-TB scheduling in CE mode B in TDD. |
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| ***Consequences if not approved:*** | Unclear or incorrect UE behavior for UL multi-TB scheduling in CE mode B |
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| ***Clauses affected:*** | 8.0 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  |  |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## 8.0 UE procedure for transmitting the physical uplink shared channel

The term "UL/DL configuration" in this Subclause refers to the higher layer parameter *subframeAssignment* unless specified otherwise.

Throughout this section, if the UE is configured with higher layer parameter *shortTTI* and the corresponding PDCCH/SPDCCH with DCI format 7-0A/7-0B is detected in a subslot, if the UE is configured for subslot uplink transmissions, **is determined based on higher layer configuration from **, otherwise**. If subslot number *n* is in subframe *N,* subslot refers to subslot number in subframe .

For a given serving cell, if a UE is configured with higher layer parameter *shortProcessingTime,* the UE is not expected to receive

- more than one uplink scheduling grants for an uplink subframe.

- PDCCH in common search space with DCI format 0 in subframe *n* and PDCCH in User-specific search space with DCI format 0/4 in the same subframe *n*.

For a serving cell, and a UE configured with higher layer parameter *ul-STTI-Length*, the UE is not expected to transmit subframe-PUSCH

- in a given subframe corresponding to PDCCH with uplink DCI format other than 7-0A/7-0B or without a corresponding PDCCH if the UE detects PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B corresponding to a PUSCH transmission in the same subframe or if the UE transmits a slot/subslot-PUSCH without a corresponding PDCCH/SPDCCH. The UE shall transmit the HARQ-ACK response corresponding to the subframe-PUSCH using the slot/subslot-PUSCH (as defined in Subclause 7.3). The UE shall apply spatial HARQ-ACK bundling on the HARQ-ACK response

- in case subslot-PUSCH is used

- in case slot-PUSCH is used if the bundling is configured for the cell.

- in a given subframe corresponding to PDCCH/EPDCCH with uplink DCI format other than 7-0A/7-0B received in subframe *n* if the UE detects PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in any subframe from subframe *n+1* to subframe *n+WUL* corresponding to a PUSCH transmission, and if  is indicated by *skipSubframeProcessing* capability [12],

- in case of a collision between the subframe-PUSCH and slot/subslot-PUCCH. The UE shall transmit the HARQ-ACK response corresponding to the subframe-PUSCH using the slot/subslot-PUCCH (as defined in Subclause 7.3). The UE shall apply spatial HARQ-ACK bundling on the HARQ-ACK response

- in case subslot-PUCCH is used

- in case slot-PUCCH is used if the bundling is configured for the cell.

- in case of a collision between the subframe-PUSCH, subframe-PUCCH, and slot/subslot-PUSCH when simultaneous PUSCH and PUCCH transmission is configured for the UE. The UE is also not expected to transmit subframe-PUCCH. The UE shall transmit the HARQ-ACK response corresponding to the subframe-PUCCH using the slot/subslot-PUSCH.

For a serving cell, and a UE configured with higher layer parameter *shortTTI*, the UE is not expected to transmit PUSCH corresponding to PDCCH/SPDCCH with CRC scrambled by the C-RNTI/SPS C-RNTI and with uplink DCI format 7-0A/7-0B

- in UpPTS of the special subframe in frame structure type 2 with special subframe configuration 0-9 or,

- for a transport block corresponding to a HARQ process with NDI not toggled if the previous PUSCH transmission of the transport block was signalled via PDCCH in UE specific search space with CRC scrambled by the C-RNTI/SPS C-RNTI with DCI format other than DCI format 7-0A/7-0B when the number of codewords for the previous PUSCH transmission is two or the transport block size is larger than the maximum transport block size supported for slot/subslot-PUSCH transmission.

For a UE configured with more than one serving cell and not capable of simultaneous transmission of different uplink signal durations to different serving cells as indicated by UE capability *simultaneousTx-differentTx-duration*, in case of a collision between

- a slot-PUSCH of first serving cell and a subframe-PUSCH/PUCCH/SRS/PRACH of second serving cell or

- a subslot-PUSCH of first serving cell and a subframe/slot-PUSCH/PUCCH/SRS/PRACH of second serving cell

the uplink transmission(s) of the second serving cell are dropped.

For a serving cell, and a UE configured with higher layer parameter *shortTTI*, the UE shall discard PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B for subslot *n* if PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B for subslot *n*-1 indicates the DMRS transmission in the first symbol of subslot *n*

- if the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B for subslot *n* does not indicate DMRS transmission in the first symbol of subslot *n*, or

- if the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B for subslot *n* indicates the DMRS transmission in the first symbol of subslot *n,*

- if the cyclic shift and/or IFDMA comb of subslot *n*-1 is not identical to that of subslot *n*, or

- if the PUSCH RBs of subslot *n*-1 is not identical to those of subslot *n*, or

- if precoding information and number of layers of subslot *n*-1 are not identical to those of subslot *n, or*

- if TPC field for subslot *n* is not '1' and if the UE is configured with higher layer parameter *accumulationEnabledsTTI*, or

- if TPC field for subslot *n-*1 is not identical to that of subslot *n* and if the UE is not configured with higher layer parameter *accumulationEnabledsTTI.*

For a serving cell, and a UE configured with higher layer parameter *totalNumberPUSCH-SPS-STTI-UL-Repetitions* or *totalNumberPUSCH-SPS-UL-Repetitions,*

- the UE is not expected to transmit PUSCH with a subframe/slot/subslot duration associated with a DCI scrambled by SPS C-RNTI colliding with ongoing PUSCH repetitions of the same subframe/slot/subslot duration associated with another DCI scrambled by SPS C-RNTI.

- for a FDD cell, the UE shall upon detection of a PDCCH/EPDCCH/SPDCCH with DCI format 0/7-0A/7-0B with CRC scrambled by SPS C-RNTI with NDI set to 0, intended for the UE, transmit the corresponding PUSCH in *k* consecutive UL subframes/slots/subslots.

- for a TDD cell not configured with higher layer parameter *symPUSCH-UpPts-r14*, the UE shall upon detection of a PDCCH/EPDCCH/SPDCCH with DCI format 0/7-0A/7-0B with CRC scrambled by SPS C-RNTI with NDI set to 0, intended for the UE, transmit the corresponding PUSCH in *k* consecutive UL subframes/slots according to the UL/DL configuration indicated by higher layer parameter *subframeAssignment*for the serving cell.

- for a TDD cell configured with higher layer parameter *symPUSCH-UpPts-r14*, the UE shall upon detection of a PDCCH/EPDCCH/SPDCCH with DCI format 0/7-0A/7-0B with CRC scrambled by SPS C-RNTI with NDI set to 0, intended for the UE, transmit the corresponding PUSCH in *k* consecutive UL subframes/slots or UpPTS according to the UL/DL configuration indicated by higher layer parameter *subframeAssignment*for the serving cell.

- f**or a TDD cell configured with UL/DL configuration 0** indicated by higher layer parameter *subframeAssignment***, the UE is not expected to receive a DCI of format 0 with CRC scrambled by SPS C-RNTI scheduling more than one PUSCH with a subframe duration by UL index.**

- for a TDD cell configured with UL/DL configuration 6 indicated by higher layer parameter *subframeAssignment* and configured with higher layer parameters *symPUSCH-UpPts-r14*, the UE is not expected to receive a DCI of format 0 with CRC scrambled by SPS C-RNTI scheduling more than one PUSCH with a subframe duration by UL index.

- f**or a TDD cell configured with UL/DL configurations 0/6** indicated by higher layer parameter *subframeAssignment***, the UE is not expected to receive a DCI of format 7-0A/7-0B with CRC scrambled by SPS C-RNTI scheduling more than one PUSCH with a slot duration by UL index.**

For a serving cell that is not a LAA SCell, and for FDD and normal HARQ operation, the UE shall upon detection on a given serving cell of a

- PDCCH/EPDCCH with DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe *n+ kp* according to the PDCCH/EPDCCH and PHICH information where ** if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, **otherwise.

- PDCCH/SPDCCH with DCI format 7-0A/7-0B intended for the UE in

- slot *n*, perform a corresponding PUSCH transmission in slot 

- subslot *n*, perform a corresponding PUSCH transmission

- in subslot if the UE is configured with subslot-based uplink transmissions, or

- in slot 0 of subframe *N* if the UE is configured with slot-based uplink transmissions, and subslot *n* (with *n* being subslot numbered from 0 to 5 within a subframe) is only one of

- subframe *N*-3, and subslot number *n*=4 or 5, or

- subframe *N*-2, and subslot number *n*=0

- in slot 1 of subframe *N* if the UE is configured with slot-based uplink transmissions, and subslot *n* belongs to subframe *N*-2, and *n* is only one of subslot number {1, 2, 3}

if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8].

For FDD-TDD and normal HARQ operation and a PUSCH for serving cell  with frame structure type 1, the UE shall upon detection of a PDCCH/EPDCCH with DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission for serving cell *c* in subframe *n+* according to the PDCCH/EPDCCH and PHICH information if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], where ** if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, **otherwise.

For normal HARQ operation, if the UE detects a PHICH transmission and if the most recent PUSCH transmission for the same transport block was using spatial multiplexing according to Subclause 8.0.2 and the UE does not detect a PDCCH/EPDCCH with DCI format 4 in subframe *n* intended for the UE, the UE shall perform the corresponding PUSCH retransmission in the associated subframe according to the PHICH information, and using the number of transmission layers and precoding matrix according to the most recent PDCCH/EPDCCH, if the number of negatively acknowledged transport blocks is equal to the number of transport blocks indicated in the most recent PDCCH/EPDCCH associated with the corresponding PUSCH.

For normal HARQ operation, if the UE detects a PHICH transmission and if the most recent PUSCH transmission for the same transport block was using spatial multiplexing according to Subclause 8.0.2 and the UE does not detect a PDCCH/EPDCCH with DCI format 4 in subframe *n* intended for the UE, and if the number of negatively acknowledged transport blocks is not equal to the number of transport blocks indicated in the most recent PDCCH/EPDCCH associated with the corresponding PUSCH then the UE shall perform the corresponding PUSCH retransmission in the associated subframe according to the PHICH information, using the precoding matrix with codebook index 0 and the number of transmission layers equal to number of layers corresponding to the negatively acknowledged transport block from the most recent PDCCH/EPDCCH. In this case, the UL DMRS resources are calculated according to the cyclic shift field for DMRS [3] in the most recent PDCCH/EPDCCH with DCI format 4 associated with the corresponding PUSCH transmission and number of layers corresponding to the negatively acknowledged transport block.

If a UE is configured with the carrier indicator field for a given serving cell, the UE shall use the carrier indicator field value from the detected PDCCH/EPDCCH with uplink DCI format to determine the serving cell for the corresponding PUSCH transmission.

For FDD and normal HARQ operation, if a PDCCH/EPDCCH/SPDCCH with CSI request field set to trigger an aperiodic CSI report, as described in Subclause 7.2.1, is detected by a UE on subframe/slot/subslot *n,* and simultaneous PUSCH and PUCCH transmission is not configured for the UE or is detected on slot/subslot *n*, thenUCI is mapped on the corresponding PUSCH transmission on,

- slot *n+4* for slot-PUSCH transmissions when the higher layer parameter *dl-STTI-Length* is set to 'slot'

- slot *0* of subframe *N+2* for slot-PUSCH transmissions in case of subslot number *n=4* or *5* in subframe *N-1*, or subslot number *n=0* in subframe *N* when the higher layer parameter *dl-STTI-Length* is set to 'subslot'

- slot *1* of subframe *N+2* for slot-PUSCH transmissions in case of subslot number *n=1* or *2* or *3* in subframe *N* when the higher layer parameter *dl-STTI-Length* is set to 'subslot'

- subslot for subslot-PUSCH transmissions

- subframe *n+ kp* where ** if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, **otherwise for subframe-PUSCH transmissions.

For FDD and a BL/CE UE configured with CEModeA, if an MPDCCH with CSI request field set to trigger an aperiodic CSI report, as described in Subclause 7.2.1, is detected by a UE on subframe *n,* then on subframe *n+4* UCI is mapped on the corresponding PUSCH transmission, including all subframe repetitions of the PUSCH transmission.

For FDD-TDD and normal HARQ operation, for a serving cell with frame structure type 1, if a PDCCH/EPDCCH/SPDCCH with CSI request field set to trigger an aperiodic CSI report, as described in Subclause 7.2.1, is detected by a UE on subframe *n,* and simultaneous PUSCH and PUCCH transmission is not configured for the UE or is detected on slot/sublost *n*, UCI is mapped on the corresponding PUSCH transmission on

- slot *n+4* for slot-PUSCH transmissions when the higher layer parameter *dl-STTI-Length* is set to 'slot';

- slot *0* of subframe *N+2* for slot-PUSCH transmissions in case of subslot number *n=4* or *5* in subframe *N-1*, or subslot *n=0* corresponding to subframe *N* when the higher layer parameter *dl-STTI-Length* is set to 'subslot';

- slot *1* of subframe *N+2* for slot-PUSCH transmissions in case of subslot number *n=1* or *2* or *3* in subframe *N* when the higher layer parameter *dl-STTI-Length* is set to 'subslot';

- subslot for subslot-PUSCH transmissions;

- subframe *n+ kp* where ** if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, **otherwise for subframe-PUSCH transmissions.

For TDD, if a UE is configured with the parameter *EIMTA-MainConfigServCell-r12* for at least one serving cell, if the UE is configured with one serving cell or if the UE is configured with more than one serving cell and the TDD UL/DL configuration of all the configured serving cells is the same, then for a given serving cell, the serving cell UL/DL configuration is the UL-reference UL/DL configuration.

For TDD, if a UE is configured with more than one serving cell and if the UL/DL configurations of at least two serving cells are different, if the serving cell is a primary cell or if the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, the serving cell UL/DL configuration is the UL-reference UL/DL configuration.

For TDD, if a UE is configured with more than one serving cell and if the UL/DL configurations of at least two serving cells are different and if the serving cell is a secondary cell and if the UE is configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, then for the serving cell, the UL reference UL/DL configuration is given in Table 8-0A corresponding to the pair formed by (other serving cell UL/DL configuration, serving cell UL/DL configuration).

For FDD-TDD and primary cell frame structure type 2, if a serving cell is a primary cell, the serving cell UL/DL configuration is the UL-reference UL/DL configuration for the serving cell.

For FDD-TDD if the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling a secondary serving cell with frame structure type 2, the serving cell UL/DL configuration is the UL-reference UL/DL configuration for the serving cell.

For FDD-TDD, and for secondary serving cell *c* with frame structure type 2, if the UE is configured to monitor PDCCH/EPDCCH in another serving cell with frame structure type 1 for scheduling the serving cell, the serving cell UL/DL configuration is the UL-reference UL/DL configuration for the serving cell.

For FDD-TDD, if a UE is configured with more than one serving cell with frame structure type 2, and if the serving cell is a secondary cell with frame structure type 2 and if the UE is configured to monitor PDCCH/EPDCCH in another serving cell with frame structure type 2 for scheduling the serving cell, then for the serving cell, the UL reference UL/DL configuration is given in Table 8-0A corresponding to the pair formed by (other serving cell UL/DL configuration, serving cell UL/DL configuration).

Table 8-0A: UL-reference UL/DL Configuration for serving cell based on the pair formed by (other serving cell UL/DL configuration, serving cell UL/DL configuration)

|  |  |  |
| --- | --- | --- |
| Set # | (other serving cell UL/DL configuration, serving cell UL/DL configuration) | UL-reference UL/DL configuration |
| Set 1 | (1,1),(1,2),(1,4),(1,5) | 1 |
| (2,2),(2,5) | 2 |
| (3,3),(3,4),(3,5) | 3 |
| (4,4),(4,5) | 4 |
| (5,5) | 5 |
| Set 2 | (1,0),(2,0),(3,0),(4,0),(5,0) | 0 |
| (2,1),(4,1),(5,1) | 1 |
| (5,2) | 2 |
| (4,3),(5,3) | 3 |
| (5,4) | 4 |
| (1,6),(2,6),(3,6),(4,6),(5,6) | 6 |
| Set 3 | (3,1) | 1 |
| (3,2),(4,2) | 2 |
| (1,3),(2,3) | 3 |
| (2,4) | 4 |
| Set 4 | (0,0),(6,0) | 0 |
| (0,1),(0,2),(0,4),(0,5),(6,1),(6,2),(6,5) | 1 |
| (0,3),(6,3) | 3 |
| (6,4) | 4 |
| (0,6),(6,6) | 6 |

If a UE is configured with the parameter *EIMTA-MainConfigServCell-r12* for a serving cell, for a radio frame of the serving cell, PUSCH transmissions can occur only in subframes that are indicated by eIMTA-UL/DL-configuration as uplink subframe(s) for the serving cell unless specified otherwise.

For TDD and normal HARQ operation, if a PDCCH/EPDCCH/SPDCCH with CSI request field set to trigger an aperiodic CSI report, as described in Subclause 7.2.1, is detected by a UE on subframe *n* and simultaneous PUSCH and PUCCH transmission is not configured for the UE or is detected by a UE on slot *n*, then on subframe/slot *n+k* UCI is mapped on the corresponding PUSCH transmission where *k* is given by

* Table 8-2m for special subframe configuration 1,2,3,4,6,7,8 if the UE is configured with higher layer parameter *ul-STTI-Length,* and the corresponding uplink DCI format is 7-0A/7-0B;
* Table 8-2n for special subframe configuration 0,5,9 if the UE is configured with higher layer parameter *ul-STTI-Length,* and the corresponding uplink DCI format is 7-0A/7-0B;
* Table 8-2p if the UE is configured with higher layer parameters *ul-STTI-Length* and *symPUSCH-UpPts-r14,* and the corresponding uplink DCI format is 7-0A/7-0B;
* Table 8-2i if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space;
* Table 8-2 otherwise.

For TDD and a BL/CE UE configured with CEModeA, if an MPDCCH with CSI request field set to trigger an aperiodic CSI report, as described in Subclause 7.2.1, is detected by a UE on subframe *n,* then on subframe *n+k* UCI is mapped on the corresponding PUSCH transmission, including all subframe repetitions of the PUSCH transmission, where *k* is given by Table 8-2.

For FDD-TDD normal HARQ operation, for a serving cell with frame structure type 2, if a PDCCH/EPDCCH with CSI request field set to trigger an aperiodic CSI report on the serving cell, as described in Subclause 7.2.1, is detected by a UE on subframe *n,* then on subframe *n+k* UCI is mapped on the corresponding PUSCH transmission where *k* is given by Table 8-2 and the "TDD UL/DL configuration" refers to the UL-reference UL/DL configuration for the serving cell, when simultaneous PUSCH and PUCCH transmission is not configured for the UE.

When a UE is configured with higher layer parameter *ttiBundling* and configured with higher layer parameter *e-HARQ-Pattern-r12* set to *FALSE* or not configured, for FDD and subframe bundling operation, the UE shall upon detection of a PDCCH/EPDCCH with DCI format 0 in subframe *n* intended for the UE, and/or a PHICH transmission in subframe *n-5* intended for the UE, perform a corresponding first PUSCH transmission in the bundle in subframe *n+4* according to the PDCCH/EPDCCH and PHICH information if a transport block corresponding to the HARQ process of the first PUSCH transmission is generated as described in [8].

When a UE is configured with higher layer parameter *ttiBundling* and configured with higher layer parameter *e-HARQ-Pattern-r12* set to *TRUE*, for FDD and subframe bundling operation, the UE shall upon detection of a PDCCH/EPDCCH with DCI format 0 in subframe *n* intended for the UE, and/or a PHICH transmission in subframe *n-1* intended for the UE, perform a corresponding first PUSCH transmission in the bundle in subframe *n+4* according to the PDCCH/EPDCCH and PHICH information if a transport block corresponding to the HARQ process of the first PUSCH transmission is generated as described in [8].

For both FDD and TDD serving cells, the NDI as signalled on PDCCH/EPDCCH/MPDCCH/SPDCCH, the RV as determined in Subclause 8.6.1, and the TBS as determined in Subclause 8.6.2, shall be delivered to higher layers.

If the UE is not configured with higher layer parameter *ul-STTI-Length,* for a non-BL/CE UE, for TDD and transmission mode 1, the number of HARQ processes per serving cell shall be determined by the UL/DL configuration (Table 4.2-2 of [3]), as indicated in Table 8-1 if the UE is not configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, otherwise the number of HARQ processes per serving cell shall be determined as

- , whereis indicated in Table 8-1a, if the UE is configured with *shortProcessingTime* and the corresponding PDCCH is in the UE-specific search space,

- indicated in Table 8-1a.

For a non-BL/CE UE, for TDD and transmission mode 2 if the UE is not configured with higher layer parameter *ul-STTI-Length*, the number of HARQ processes per serving cell for non-subframe bundling operation shall be twice the number determined by the UL/DL configuration (Table 4.2-2 of [3]) for TDD and transmission mode 1 there are two HARQ processes associated with a given subframe as described in [8]. For TDD and both transmission mode 1 and transmission mode 2, the "TDD UL/DL configuration" in Table 8-1 and Table 8-1a refers to the UL-reference UL/DL configuration for the serving cell if UL-reference UL/DL configuration is defined for the serving cell and refers to the serving cell UL/DL configuration otherwise.

For a non-BL/CE UE configured higher layer parameter *ul-STTI-Length*, if the UE is configured with *shortProcessingTime* and transmission mode 2 for subframe-PUSCH the number of HARQ processes per TDD serving cell for non-subframe bundling operation is 32, and 16 otherwise. There are two HARQ processes for transmission mode 2 of subframe-PUSCH associated with a given subframe as described in [8].

For a BL/CE UE configured with CEModeA and for TDD, the maximum number of HARQ processes per serving cell shall be determined by the UL/DL configuration (Table 4.2-2 of [3]) according to the normal HARQ operation in Table 8-1. For TDD a BL/CE UE configured with CEModeB is not expected to support more than 4 uplink HARQ processes per serving cell if the UE is configured with higher layer parameter *ce-PUSCH-MultiTB-Config,* 2 uplink HARQ processes per serving cell otherwise.

Table 8-1: Number of synchronous UL HARQ processes for TDD

|  |  |  |
| --- | --- | --- |
| TDD UL/DL configuration | Number of HARQ processes for normal HARQ operation | Number of HARQ processes for subframe bundling operation |
| 0 | 7 | 3 |
| 1 | 4 | 2 |
| 2 | 2 | N/A |
| 3 | 3 | N/A |
| 4 | 2 | N/A |
| 5 | 1 | N/A |
| 6 | 6 | 3 |

Table 8-1a: Number of synchronous UL HARQ processes for TDD and UE configured with *symPUSCH-UpPts-r14*

|  |  |  |
| --- | --- | --- |
| TDD UL/DL configuration | Number of HARQ processes for normal HARQ operation | Number of HARQ processes for subframe bundling operation |
| 0 | 9 | N/A |
| 1 | 6 | N/A |
| 2 | 4 | 2 |
| 3 | 4 | 2 |
| 4 | 3 | N/A |
| 5 | 2 | N/A |
| 6 | 8 | N/A |

For TDD, if the UE is not configured with *EIMTA-MainConfigServCell-r12* for any serving cell, and if a UE is configured with one serving cell, or if the UE is configured with more than one serving cell and the TDD UL/DL configuration of all the configured serving cells is the same,

- For TDD UL/DL configurations 1-6 and normal HARQ operation and UE not configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/EPDCCH/SPDCCH with uplink DCI format in subframe/slot *n* and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe/slot *n+k*, with *k* given in

- Table 8-2m for special subframe configuration 1, 2, 3, 4, 6, 7, 8 if the UE is configured with higher layer parameter *ul-STTI-Length,* and the corresponding uplink DCI format is 7-0A/7-0B

- Table 8-2n for special subframe configuration 0, 5, 9 if the UE is configured with higher layer parameter *ul-STTI-Length,* and the corresponding uplink DCI format is 7-0A/7-0B

- For TDD UL/DL configuration 6 and for *n=0, 1, 2, 10, 11, 12*

- If only the MSB of the UL index in the uplink DCI is set in slot *n*, the UE shall perform a corresponding PUSCH transmission in slot *n+ k*

- If only the LSB of the UL index in the uplink DCI is set in slot *n*, the UE shall perform a corresponding PUSCH transmission in slot *n+ k+1*

- If both the MSB and LSB of the UL index in the uplink DCI are set in slot *n*, the UE shall perform a corresponding PUSCH transmission in both slot *n+ k* and *n+ k+1,* wherethe HARQ process number of the PUSCH in slot *n+k* is  and the HARQ process number of the PUSCH in *n+k+1* is  with  from the HARQ process number field in the corresponding DCI format.

- Table 8-2i if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with DCI format 0/4 and with CRC scrambled by C-RNTI is in the UE-specific search space,

- Table 8-2 otherwise,

according to the PDCCH/EPDCCH/SPDCCH and PHICH information if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8].

- For TDD UL/DL configuration 0 and normal HARQ operation the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe *n+k* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8] and if the MSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 is set to 1 or PHICH is received in subframe *n*=0 or 5 in the resource corresponding to , as defined in Subclause 9.1.2, or PHICH is received in subframe *n*=1 or 6 corresponding to PUSCH transmission in subframe *n-5* for UE configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell. If, for TDD UL/DL configuration 0 and normal HARQ operation, the LSB of the UL index in the DCI format 0/4 is set to 1 in subframe *n* or a PHICH is received in subframe *n*=0 or 5 in the resource corresponding to , as defined in Subclause 9.1.2, or PHICH is received in subframe *n*=1 or 6 corresponding to PUSCH transmission in subframe *n-4*, the UE shall perform a corresponding PUSCH transmission in subframe *n+ kp* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. If, for TDD UL/DL configuration 0, both the MSB and LSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 are set in subframe *n*, the UE shall perform a corresponding PUSCH transmission in both subframes *n+ k* and *n+ kp* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in

- Table 8-2g if the UE is configured with higher layer parameter *symPUSCH-UpPts-r14* and the UE is either not configured with higher layer parameter *shortProcessingTime* for the serving cell or is configured with higher layer parameter *shortProcessingTime* for the serving cell and the corresponding PDCCH is in the common search space,

- Table 8-2i if the UE is not configured with higher layer parameter *symPUSCH-UpPts-r14* and the UE is configured with higher layer parameter *shortProcessingTime* for the serving cell and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

- Table 8-2j if the UE is configured with higher layer parameters *symPUSCH-UpPts-r14* and *shortProcessingTime* for the serving cell and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

- Table 8-2 otherwise.

** if the UE is configured with higher layer parameters *symPUSCH-UpPts-r14* and *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, or if *n=*1 or 6 and the UE is not configured with higher layer parameter *symPUSCH-UpPts-r14* but is configured with *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, **otherwise.

In case the UE is configured with higher layer parameter *shortProcessingTime* for the serving cell and both the MSB and LSB of the UL index in the PDCCH with uplink DCI format 0/4 with the UE's C-RNTI in the UE-specific search space are set to 1, the HARQ process number of the PUSCH in subframe *n+k* is  and the HARQ process number of the PUSCH in subframe *n+kp* is , where  is determined according to the *HARQ process number* field in the corresponding DCI format and *M*UL\_HARQ ­is the number of UL HARQ processes per cell for transmission mode 1 and half the number of UL HARQ processes per cell for transmission mode 2.

- For TDD UL/DL configuration 0 and normal HARQ operation the UE shall upon detection of a PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in slot *n* intended for the UE, perform a corresponding PUSCH transmission in slot *n+k* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in

- Table 8-2m for special subframe configuration 1, 2, 3, 4, 6, 7, 8, and in Table 8-2n for special subframe configuration 0, 5, 9

- If only the MSB of the UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B is set in slot *n*, the UE shall perform a corresponding PUSCH transmission in slot *n+ k*

- If only the LSB of the UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B is set in slot *n*, the UE shall perform a corresponding PUSCH transmission in slot *n+ k+1*

- If both the MSB and LSB of the UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B are set in slot *n*, the UE shall perform a corresponding PUSCH transmission in both slot *n+ k* and *n+ k+1,* wherethe HARQ process number of the PUSCH in slot *n+k* is  and the HARQ process number of the PUSCH in *n+k+1* is  with  from the HARQ process number field in the corresponding DCI format.

- The UE is not expected to receive LSB of the UL index in PDCCH/SPDCCH with uplink DCI format set to 1 in slot *n=0, 1, 10 and 11* for special subframe configuration 1, 2, 3, 4, 6, 7, 8

- Table 8-2p if the UE is configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell

- If UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in slot *n=2* or *n=12* is set to

- '10', the UE shall perform a corresponding PUSCH transmission in slot *n+k*

- '01', the UE shall perform a corresponding PUSCH transmission in slot *n+ k+1*

- '11', the UE shall perform a corresponding PUSCH transmission in slot *n+ k+5*

- '00', the UE shall perform a corresponding PUSCH transmission in slot *n+ k, n+k+1,* and *n+k+5,* wherethe HARQ process number of the PUSCH in slot *n+k* is , the HARQ process number of the PUSCH in *n+k+1* is , and the HARQ process number of the PUSCH in *n+k+5* is  with  from the HARQ process number field in the corresponding DCI format.

- If UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in slot *n=0, 1, 10 or 11* is set to

- '10', the UE shall perform a corresponding PUSCH transmission in slot *n+ k*

- '01', the UE shall perform a corresponding PUSCH transmission in slot *n+ k+1*

- '11', the UE shall perform a corresponding PUSCH transmission in slot *n+ k* and *n+k+1,* wherethe HARQ process number of the PUSCH in slot *n+k* is  and the HARQ process number of the PUSCH in *n+k+1* is with  from the HARQ process number field in the corresponding DCI format.

- For TDD UL/DL configurations 1-5 and normal HARQ operation and UE configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/EPDCCH/SPDCCH with uplink DCI format in subframe/slot *n* intended for the UE, and/or a PHICH transmission intended for the UE in subframe *n+l* with *l* given in Table 8-2h, perform a corresponding PUSCH transmission in subframe/slot *n+k*, with *k* given in Table 8-2j if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI Format 0/4 and is in the UE-specific search space, Table 8-2p if the corresponding PDCCH/SPDCCH has DCI format 7-0A/7-0B, in Table 8-2g otherwise, according to the PDCCH/EPDCCH and/or PHICH information if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8].

- For TDD UL/DL configuration 6 and normal HARQ operation and UE configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe *n+k* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8] and if the MSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 is set to 1 or PHICH is received in subframe *n*=1 or 6 or 9, or PHICH is received in subframe *n*=0 corresponding to PUSCH transmission in subframe *n-6*, or PHICH is received in subframe *n*=5 corresponding to PUSCH transmission in subframe *n-7*, with *k* given in Table 8-2j if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 and is in the UE-specific search space, in Table 8-2g otherwise. If, for TDD UL/DL configuration 6 and normal HARQ operation, the LSB of the UL index in the DCI format 0/4 is set to 1 in subframe *n,* or PHICH is received in subframe *n*=0 or 5 corresponding to PUSCH transmission in subframe *n-4*, the UE shall perform a corresponding PUSCH transmission in subframe *n+ kp* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. If, for TDD UL/DL configuration 6, both the MSB and LSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 are set in subframe *n*, the UE shall perform a corresponding PUSCH transmission in both subframes *n+ k* and *n+ kp* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in Table 8-2j if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 and is in the UE-specific search space, in Table 8-2g otherwise. In case the UE is configured with higher layer parameter *shortProcessingTime* for the serving cell and both the MSB and LSB of the UL index in the PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 in the UE-specific search space are set to 1, the HARQ process number of the PUSCH in subframe *n+k* is  and the HARQ process number of the PUSCH in subframe *n+kp* is , where  is determined according to the *HARQ process number* field in the corresponding DCI format and *M*UL\_HARQ is the number of UL HARQ processes per cell for transmission mode 1 and half the number of UL HARQ processes per cell for transmission mode 2. Note that **is given as,

*- * if ** or 9and the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

*- * if *n*=1, 5, or 6and the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

*- *otherwise.

The UE is not expected to receive LSB of the UL index in PDCCH/EPDCCH with uplink DCI format 0/4 set to 1 in subframe *n=9* unless the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 in the UE-specific search space.

- For TDD UL/DL configuration 6 and normal HARQ operation and the UE is configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in slot *n* intended for the UE, perform a corresponding PUSCH transmission in slot *n+k* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in Table 8-2p

- If UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in slot *n=2* is set to

- '10', the UE shall perform a corresponding PUSCH transmission in slot *n+k*

- '01', the UE shall perform a corresponding PUSCH transmission in slot *n+ k+1*

- '11', the UE shall perform a corresponding PUSCH transmission in slot *n+ k+5*

- '00', the UE shall perform a corresponding PUSCH transmission in slot *n+ k, n+k+1,* and *n+k+5,* wherethe HARQ process number of the PUSCH in slot *n+k* is , the HARQ process number of the PUSCH in *n+k+1* is , and the HARQ process number of the PUSCH in *n+k+5* is  with  from the HARQ process number field in the corresponding DCI format.

- If UL index in the PDCCH/SPDCCH with uplink DCI format 7-0A/7-0B in slot *n=0, 1, 10, 11, 12, 19* is set to

- '10', the UE shall perform a corresponding PUSCH transmission in slot *n+ k*

- '01', the UE shall perform a corresponding PUSCH transmission in slot *n+ k+1*

- '11', the UE shall perform a corresponding PUSCH transmission in slot *n+ k* and *n+k+1*, wherethe HARQ process number of the PUSCH in slot *n+k* is  and the HARQ process number of the PUSCH in *n+k+1* is  with  from the HARQ process number field in the corresponding DCI format.

For TDD, if a UE is configured with more than one serving cell and the TDD UL/DL configuration of at least two configured serving cells is not the same or if the UE is configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell, or FDD-TDD,

- For a serving cell with an UL-reference UL/DL configurations belonging to {1,2,3,4,5,6} and normal HARQ operation and UE not configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe *n+k* for the serving cell according to the PDCCH/EPDCCH and/or PHICH information if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in Table 8-2i if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 in the UE-specific search space, in Table 8-2 otherwise, where the "TDD UL/DL Configuration" given in Table 8-2 refers to the UL-reference UL/DL configuration.

- For a serving cell with UL-reference UL/DL configuration 0 and normal HARQ operation the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe *n+k* for the serving cell if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8] and if the MSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 is set to 1 or PHICH is received in subframe *n*=0 or 5 in the resource corresponding to , as defined in Subclause 9.1.2, or PHICH is received in subframe *n*=1 or 6 corresponding to PUSCH transmission in subframe *n-5* for UE configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell. If, for a serving cell with UL-reference UL/DL configuration 0 and normal HARQ operation, the LSB of the UL index in the DCI format 0/4 is set to 1 in subframe *n* or a PHICH is received in subframe *n*=0 or 5 in the resource corresponding to , as defined in Subclause 9.1.2, or PHICH is received in subframe *n*=1 or 6 corresponding to PUSCH transmission in subframe *n-4*, the UE shall perform a corresponding PUSCH transmission in subframe *n+ kp* for the serving cell if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. If, for a serving cell with UL-reference UL/DL configuration 0, both the MSB and LSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 are set in subframe *n*, the UE shall perform a corresponding PUSCH transmission in both subframes *n+ k* and *n+ kp* for the serving cell if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. In case the UE is configured with higher layer parameter *shortProcessingTime* for the serving cell and both the MSB and LSB of the UL index in the PDCCH with uplink DCI format 0/4 with the UE's C-RNTI in the UE-specific search space are set to 1, the HARQ process number of the PUSCH in subframe *n+k* is  and the HARQ process number of the PUSCH in subframe *n+kp* is , where  is determined according to the *HARQ process number* field in the corresponding DCI format and *M*UL\_HARQ is the number of UL HARQ processes per cell for transmission mode 1 and half the number of UL HARQ processes per cell for transmission mode 2. Note that *k* is given in

- Table 8-2gif the UE is configured with higher layer parameter *symPUSCH-UpPts-r14* and the UE is either not configured with higher layer parameter *shortProcessingTime* for the serving cell or is configured with higher layer parameter *shortProcessingTime* for the serving cell and the corresponding PDCCH with CRC scrambled by C-RNTI is in the common search space,

- Table 8-2i if the UE is not configured with higher layer parameter *symPUSCH-UpPts-r14* and the UE is configured with higher layer parameter *shortProcessingTime* for the serving cell and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

- Table 8-2j if the UE is configured with higher layer parameters *symPUSCH-UpPts-r14* and *shortProcessingTime* for the serving cell and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

- Table 8-2 otherwise,

where the "TDD UL/DL Configuration" given in Table 8-2, Table 8-2g, Table 8-2i, Table 8-2j refers to the UL-reference UL/DL configuration. Note that if the UE is configured with higher layer parameters *symPUSCH-UpPts-r14* and *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, or if *n* =1 or 6 and the UE is not configured with higher layer parameter *symPUSCH-UpPts-r14* but is configured with *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, **otherwise.

- For a serving cell with an UL-reference UL/DL configurations belonging to {1,2,3,4,5} and normal HARQ operation and UE configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format 0/4 in subframe *n* intended for the UE, and/or a PHICH transmission intended for the UE in subframe *n+l* with *l* given in Table 8-2h, perform a corresponding PUSCH transmission in subframe *n+k* for the serving cell according to the PDCCH/EPDCCH and/or PHICH information if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in Table 8-2j if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 in the UE-specific search space, in Table 8-2g otherwise, where the "TDD UL/DL Configuration" given in Table 8-2g, Table 8-2h and Table 8-2j refers to the UL-reference UL/DL configuration.

- For a serving cell with UL-reference UL/DL configuration configuration 6 and normal HARQ operation and UE configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format 0/4 and/or a PHICH transmission in subframe *n* intended for the UE, perform a corresponding PUSCH transmission in subframe *n+k* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8] and if the MSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 is set to 1 or PHICH is received in subframe *n*=1 or 6 or 9, or PHICH is received in subframe *n*=0 corresponding to PUSCH transmission in subframe *n-6*, or PHICH is received in subframe *n*=5 corresponding to PUSCH transmission in subframe *n-7*, with *k* given in Table 8-2j if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 in the UE-specific search space, in Table 8-2g otherwise. If, for a serving cell with UL-reference UL/DL configuration 6 and normal HARQ operation, the LSB of the UL index in the DCI format 0/4 is set to 1 in subframe *n,* or PHICH is received in subframe *n*=0 or 5 corresponding to PUSCH transmission in subframe *n-4*, the UE shall perform a corresponding PUSCH transmission in subframe *n+ kp* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. If, for a serving cell with UL-reference UL/DL configuration 6, both the MSB and LSB of the UL index in the PDCCH/EPDCCH with uplink DCI format 0/4 are set in subframe *n*, the UE shall perform a corresponding PUSCH transmission in both subframes *n+ k* and *n+ kp* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8], with *k* given in Table 8-2j if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI has DCI format 0/4 in the UE-specific search space, in Table 8-2g otherwise, where the "TDD UL/DL Configuration" given in Table 8-2g and Table 8-2j refers to the UL-reference UL/DL configuration. In case the UE is configured with higher layer parameter *shortProcessingTime* for the serving cell and both the MSB and LSB of the UL index in the PDCCH with uplink DCI format 0/4 with the UE's C-RNTI in the UE-specific search space are set to 1, the HARQ process number of the PUSCH in subframe *n+k* is  and the HARQ process number of the PUSCH in subframe *n+kp* is , where  is determined according to the *HARQ process number* field in the corresponding DCI format and *M*UL\_HARQ is the number of UL HARQ processes per cell for transmission mode 1 and half the number of UL HARQ processes per cell for transmission mode 2. Note that *kp* is given as,

*- * if *n* = 0 or 9 and the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

*- * if *n*=1, 5, or 6 and the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space,

*- *otherwise.

The UE is not expected to receive LSB of the UL index in PDCCH/EPDCCH with uplink DCI format set to 1 in subframe *n=9* unless the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space*.*

For TDD UL/DL configurations 1, 2, 3 and 6 and subframe bundling operation, the UE shall upon detection of a PDCCH/EPDCCH with DCI format 0 in subframe *n* intended for the UE, and/or a PHICH transmission intended for the UE in subframe *n-l* with *l* given in Table 8-2a, perform a corresponding first PUSCH transmission in the bundle in subframe *n+k* according to the PDCCH/EPDCCH and/or PHICH information if a transport block corresponding to the HARQ process of the first PUSCH transmission is generated as described in [8], with *k* given in Table 8-2 if the UE is not configured with higher layer parameter *symPUSCH-UpPts-r14* for the serving cell, otherwise *k* given in Table 8-2g.

For TDD UL/DL configuration 0 and subframe bundling operation, the UE shall upon detection of a PDCCH/EPDCCH with DCI format 0 in subframe *n* intended for the UE, and/or a PHICH transmission intended for the UE in subframe *n-l* with *l* given in Table 8-2a, perform a corresponding first PUSCH transmission in the bundle in subframe *n+k* according to the PDCCH/EPDCCH and PHICH information if a transport block corresponding to the HARQ process of the first PUSCH transmission is generated as described in [8] and if the MSB of the UL index in the DCI format 0 is set to 1 or if , as defined in Subclause 9.1.2, with *k* given in Table 8-2. If, for TDD UL/DL configuration 0 and subframe bundling operation, the LSB of the UL index in the PDCCH/EPDCCH with DCI format 0 is set to 1 in subframe *n* or if , as defined in Subclause 9.1.2, the UE shall perform a corresponding first PUSCH transmission in the bundle in subframe *n+7*, according to the PDCCH/EPDCCH and PHICH information if a transport block corresponding to the HARQ process of the first PUSCH transmission is generated as described in [8].

Table 8-2: *k* for TDD configurations 0-6

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 4 | 6 |  |  |  | 4 | 6 |  |  |  |
| 1 |  | 6 |  |  | 4 |  | 6 |  |  | 4 |
| 2 |  |  |  | 4 |  |  |  |  | 4 |  |
| 3 | 4 |  |  |  |  |  |  |  | 4 | 4 |
| 4 |  |  |  |  |  |  |  |  | 4 | 4 |
| 5 |  |  |  |  |  |  |  |  | 4 |  |
| 6 | 7 | 7 |  |  |  | 7 | 7 |  |  | 5 |

Table 8-2a: *l* for TDD configurations 0, 1, 2, 3 and 6

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 9 | 6 |  |  |  | 9 | 6 |  |  |  |
| 1 |  | 2 |  |  | 3 |  | 2 |  |  | 3 |
| 2 |  | 3 |  | 0 |  |  | 3 |  | 0 |  |
| 3 | 1 |  |  |  |  |  |  | 7 | 0 | 1 |
| 6 | 5 | 5 |  |  |  | 6 | 6 |  |  | 8 |

Table 8-2g: *k* for TDD configurations 0-6 and UE configured with *symPUSCH-UpPts-r14*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 4 | 5 |  |  |  | 4 | 5 |  |  |  |
| 1 | 6 | 6 |  |  | 4 | 6 | 6 |  |  | 4 |
| 2 |  | 5 |  | 4 |  |  | 5 |  | 4 |  |
| 3 | 4 |  |  |  |  |  |  | 4 | 4 | 4 |
| 4 |  |  |  |  |  |  |  | 4 | 4 | 4 |
| 5 |  |  |  |  |  |  |  | 4 | 4 |  |
| 6 | 7 | 7 |  |  |  | 7 | 7 |  |  | 5 |

Table 8-2h: *l* for TDD configurations 1-5 and UE configured with *symPUSCH-UpPts-r14*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 1 | 0 |  |  | 0 | 1 | 0 |  |  | 0 |
| 2 |  | 2 |  | 0 |  |  | 2 |  | 0 |  |
| 3 | 0 |  |  |  |  |  |  | 1 | 0 | 0 |
| 4 |  |  |  |  |  |  |  | 1 | 0 | 0 |
| 5 |  |  |  |  |  |  |  | 1 | 0 |  |

Table 8-2i: k for TDD configurations 0-6 and UE configured with *shortProcessingTime*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 3 | 3 |  |  |  | 3 | 3 |  |  |  |
| 1 | 3 |  |  |  | 3 | 3 |  |  |  | 3 |
| 2 |  |  |  |  | 3 |  |  |  |  | 3 |
| 3 | 3 | 3 |  |  |  |  |  |  |  | 3 |
| 4 | 3 |  |  |  |  |  |  |  |  | 3 |
| 5 |  |  |  |  |  |  |  |  |  | 3 |
| 6 | 4 | 6 |  |  |  | 3 | 6 |  |  | 4 |

Table 8-2j: k for TDD configurations 0-6 UE configured with *shortProcessingTime* and with *symPUSCH-UpPts-r14*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 3 | 3 |  |  |  | 3 | 3 |  |  |  |
| 1 | 3 | 5 |  |  | 3 | 3 | 5 |  |  | 3 |
| 2 |  |  |  | 3 | 3 |  |  |  | 3 | 3 |
| 3 | 3 | 3 |  |  |  |  |  |  | 3 | 3 |
| 4 | 3 |  |  |  |  |  |  |  | 3 | 3 |
| 5 |  |  |  |  |  |  |  |  | 3 | 3 |
| 6 | 3 | 5 |  |  |  | 3 | 5 |  |  | 3 |

Table 8-2m: k for TDD configurations 0-6, special subframe configuration 1,2,3,4,6,7,8 and UE configured with *ul-STTI-Length*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | slot number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 0 | 4 | 4 | 4 | 5 |  |  |  |  |  |  | 4 | 4 | 4 | 5 |  |  |  |  |  |  |
| 1 | 4 | 4 | 4 | 4　 |  |  |  |  |  |  | 4 | 4 | 4 | 4　 |  |  |  |  |  |  |
| 2 | 4　 | 4　 |  |  |  |  |  |  |  |  | 4　 | 4　 |  |  |  |  |  |  |  |  |
| 3 | 6 | 6 | 6 | 6　 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 6 | 6 |
| 4 | 4 | 4 | 4 | 4　 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 | 4　 | 4　 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | 6 | 6 | 6 | 6　 |  |  |  |  |  |  | 4 | 4 | 4 | 4　 |  |  |  |  | 6　 | 6　 |

Table 8-2n: k for TDD configurations 0-6, special subframe configuration 0,5,9 and UE configured with *ul-STTI-Length*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | slot number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 0 | 4 | 5 | 6 |  |  |  |  |  |  |  | 4 | 5 | 6 |  |  |  |  |  |  |  |
| 1 | 5 | 5　 | 5 |  |  |  |  |  |  | 5 | 5 | 5　 | 5 |  |  |  |  |  |  | 5　 |
| 2 | 4　 | 4　 |  |  |  |  |  |  |  |  | 4　 | 4　 |  |  |  |  |  |  |  |  |
| 3 | 7　 | 7　 | 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 7　 | 7　 | 7　 |
| 4 | 5　 | 5　 | 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5　 |
| 5 | 4　 | 4　 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | 4　 | 5 | 6 |  |  |  |  |  |  |  | 4 | 4 | 4 |  |  |  |  |  |  |  |

Table 8-2p: k for TDD configurations 0-6, UE configured with *symPUSCH-UpPts-r14*, and *ul-STTI-Length*

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | slot number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 0 | 4 | 5 | 6 |  |  |  |  |  |  |  | 4 | 5 | 6 |  |  |  |  |  |  |  |
| 1 | 5 | 5　 | 5 |  |  |  |  |  | 5　 | 5 | 5 | 5　 | 5 |  |  |  |  |  | 5　 | 5　 |
| 2 | 4　 | 4　 |  |  |  |  |  |  |  | 4　 | 4　 | 4　 |  |  |  |  |  |  |  | 4　 |
| 3 | 7　 | 7　 | 7 |  |  |  |  |  |  |  |  |  |  |  |  |  | 7　 | 7　 | 7　 | 7　 |
| 4 | 5　 | 5　 | 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5　 | 5　 |
| 5 | 4　 | 4　 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 4　 |
| 6 | 4　 | 5 | 6 |  |  |  |  |  |  |  | 4 | 4 | 4 |  |  |  |  |  |  | 4　 |

For BL/CE UEs, the set of BL/CE UL subframes is indicated as follows

- If higher layer parameter *resourceReservationDedicatedUL* is configured,

- for PUSCH transmission associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space including PUSCH transmission without a corresponding MPDCCH,

- if the Resource reservation field in the DCI is set to 0, then the set of BL/CE UL subframes corresponds to all uplink subframes during the PUSCH transmission;

- if the Resource reservation field in the DCI is set to 1, then the set of BL/CE UL subframes corresponds to all uplink subframes that are not fully reserved according to higher layer parameters (a subframe is considered fully reserved if and only if all SC-FDMA symbols of the PUSCH transmission are reserved in the subframe);

- for PUCCH transmission associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space including PUSCH transmission without a corresponding MPDCCH,

- the set of BL/CE UL subframes corresponds to all uplink subframes that are not fully reserved according to higher layer parameters (a subframe is considered fully reserved if and only if all SC-FDMA symbols of the PUCCH transmission are reserved in the subframe).

- In all other cases, the set of BL/CE UL subframes is indicated by the higher layers according to *fdd-DownlinkOrTddSubframeBitmapBR* and *fdd-UplinkSubframeBitmapBR* [11].

For BL/CE UEs, PUSCH transmission can be scheduled by a MPDCCH with DCI format 6-0A/6-0B, or the transmission can correspond to using preconfigured uplink resource configured by higher layers. Transmission using preconfigured uplink resource is initiated by higher layers as specified in [14], while retransmission of transport blocks transmitted using preconfigured uplink resource are scheduled by a MPDCCH with DCI format 6-0A/6-0B.

For a PUSCH transmission using preconfigured uplink resource, the UE shall use the repetition number determined by the repetition adjustment field according to Table 8-2b and Table 8-2c from the most recent MPDCCH DCI format 6-0A/6-0B with CRC scrambled by PUR C-RNTI for PUR ACK/fallback indication (as defined in [4]) if detected, configured by higher layers otherwise.

A BL/CE UE shall upon detection on a given serving cell of an MPDCCH with DCI format 6-0A/6-0B scheduling PUSCH intended for the UE, perform a corresponding PUSCH transmission in subframe(s) *ni* = *n+ki* if a transport block(s) corresponding to the HARQ process(es) of the PUSCH transmission is generated as described in [8] with *i = 0, 1, …, NTBN-1* according to the MPDCCH, where

- subframe *n* is the last subframe in which the MPDCCH is transmitted;

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

*-*  and the value of  is determined by the *repetition number* field in the corresponding DCI, where

- if the UE is configured with higher layer parameter *ce-pdsch-puschEnhancement-config* with value 'On' are given by {1,2,4,8,12,16,24,32}

- otherwise, are given in Table 8-2b and Table 8-2c; and

- if the UE is configured with higher layer parameter *ce-PUSCH-SubPRB-Config-r15*, and the PUSCH resource assignment in the corresponding DCI is using uplink resource allocation type 5,  where *N* ≤ 32 for CE Mode A and *N* ≤ 2048 for CE Mode B,  is defined in [3] and  is determined according to procedure in subclause 8.1.6,  otherwise

- in case *N>1*, subframe(s) *n+ki* with *i=0,1,…, NTBN-1* are *NTBN* consecutive BL/CE UL subframe(s) starting with subframe *n+x*, and in case *N=1*, *k0=x*;

- for ,

- if the UE is configured with higher layer parameter *interleaving* in *ce-PUSCH-MultiTB-Config*, and PUSCH corresponding to a MPDCCH with DCI CRC scrambled by C-RNTI and 

- where $C=\frac{M\_{slots}^{UL}}{2}∙M\_{RU}$ if the UE is configured with higher layer parameter *ce-PUSCH-SubPRB-Config-r15* and the PUSCH resource assignment is using uplink resource allocation type 5, otherwise  for UE configured with CEModeA, and  for UE configured with CEModeB,

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

- otherwise,

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

- the HARQ process ID for each of the scheduled  TBs are determined from the value of the 'HARQ index with offset' in the 'Scheduling TBs for Unicast' field for CEmodeA or the 'HARQ index' in the 'Scheduling TBs for Unicast' field for CEmodeB in the corresponding DCI which is a combinatorial index *r* defined as $+r\_{offset}$, where

- the set , (**) contains the sorted HARQ process IDs and  is the extended binomial coefficient, resulting in unique label $+r\_{offset}$,

- $r\_{offset}$ is the offset value as defined in 5.3.3.1.10 of [4] for CE mode A, and $r\_{offset}=0$ for CE mode B,

-  if UE is configured with CEModeA, and  if UE is configured with CEModeB.

- for FDD, *x = 4*;

- for TDD UL/DL configurations 1-6, or for TDD UL/DL configuration 0 and a BL/CE UE in CEModeB, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; If the value x is not given in Table 8-2 for subframe *n*, denote subframe *n'* as the first downlink/special subframe which has a value in Table 8-2 after subframe *n*, and substitute *n* with *n'* in the above procedure for performing the PUSCH transmission.

- for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA, if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, *x = 7.* The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *N>1*. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 6-0A

- The higher layer parameter *ttiBundling* is not applicable to BL/CE UEs.

- For a BL/CE UE, in case a PUSCH transmission with a corresponding MPDCCH collides with a PUSCH transmission without a corresponding MPDCCH in a subframe *n*, the PUSCH transmission without a corresponding MPDCCH is dropped from subframe *n*.

- For a BL/CE UE, in case of collision between at least one physical resource block to be used for PUSCH transmission and physical resource blocks corresponding to configured PRACH resources for BL/CE UEs or non-BL/CE UEs (defined in [3]) in a same subframe, the PUSCH transmission is dropped in that subframe.

- For a BL/CE UE in half-duplex FDD operation, in case a PUSCH transmission including half-duplex guard subframe without a corresponding MPDCCH collides partially or fully with a PDSCH transmission with a corresponding MPDCCH, the PUSCH transmission without a corresponding MPDCCH is dropped.

- For a BL/CE UE in half-duplex FDD operation and configured with *ce-pdsch-puschEnhancement-config*, in case a PUSCH transmission including half-duplex guard subframe collides partially or fully with a PDSCH transmission without a corresponding MPDCCH, the PUSCH transmission is dropped.

For BL/CE UEs, and for a PUSCH transmission starting in subframe *n+ k0* without a corresponding MPDCCH, the UE shall adjust the PUSCH transmission in subframe(s) *n+ki* with *i = 0, 1, …, N-1,* 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 8-2b and Table 8-2c; and

- if the UE is configured with higher layer parameter *ce-PUSCH-SubPRB-Config-r15*, and the PUSCH resource assignment in the activation DCI is using uplink resource allocation type 5,  where  is defined in [3] and  is determined according to procedure in subclause 8.1.6,  otherwise

- in case *N>1*, subframe(s) *n+ki* with *i=0,1,…,N-1* are *N* consecutive BL/CE UL subframe(s), and in case *N=1*, *k0=0*;

A BL/CE UE configured with *mpdcch-UL-HARQ-ACK-FeedbackConfig* shall upon detection on a given serving cell of an MPDCCH with DCI format 6-0A/6-0B intended for the UE in the UE-specific search space indicating HARQ-ACK corresponding to a transport block associated to a HARQ process in the most recent PUSCH transmission with *N>1*, drop the remaining PUSCH transmission(s) (if any) corresponding to the transport block no later than subframe *n+k*, where

* subframe *n* is the last subframe in which the MPDCCH is transmitted; and
* for FDD, *k = 4*;
* for TDD the value of *k* is given in Table 8-2 for the corresponding TDD UL/DL configuration; If the value of *k* is not given in Table 8-2 for subframe *n*, denote subframe *n'* as the first downlink/special subframe which has a value in Table 8-2 after subframe *n*, and substitute *n* with *n'* in the above procedure;
* value of is determined by the *repetition number* field in the corresponding DCI associated with the most recent PUSCH transmission;
* if the UE is configured with higher layer parameter *ce-PUSCH-SubPRB-Config-r15*, and the PUSCH resource assignment in the corresponding DCI associated with the most recent PUSCH transmission is using uplink resource allocation type 5,  where  is defined in [3] and  is determined according to procedure in subclause 8.1.6,  otherwise.

For a BL/CE UE configured with *mpdcch-UL-HARQ-ACK-FeedbackConfig*, if the UE detects a first MPDCCH with DCI format 6-0A/6-0B intended for the UE scheduling PUSCH in subframes $\{s\_{0},…,s\_{N-1}\}$, and if the UE detects a second MPDCCH with DCI format 6-0A/6-0B intended for the UE scheduling PUSCH in subframes $\{q\_{0},…,q\_{L-1}\}$ with $M\leq q\_{0}\leq s\_{N-1}$, where

- the HARQ ID indicated in the second MPDCCH is different from the HARQ ID indicated in the first MPDCCH or the NDI indicated in the second MPDCCH is toggled with respect to the NDI indicated in the first MPDCCH, and

- the first subframe $M$ in which the second MPDCCH is transmitted meets $M\geq s\_{0}+k$ and

- for FDD, *k = 4*,

- for TDD the value of *k* is given in Table 8-2 for the corresponding TDD UL/DL configuration; If the value of *k* is not given in Table 8-2 for subframe *n*, denote subframe *n'* as the first downlink/special subframe which has a value in Table 8-2 after subframe *n*, and substitute *n* with *n'* in the above procedure

the UE shall

- drop the remaining PUSCH transmission(s) of the transport block scheduled by the first MPDCCH starting from subframe $K$, where $M<K\leq q\_{0}$, and

- deliver HARQ-ACK feedback corresponding to the transport block scheduled by the first MPDCCH to higher layers, and

- transmit the PUSCH scheduled by the second MPDCCH in subframes $\{q\_{0},…,q\_{L-1}\}$

Table 8-2b: PUSCH repetition levels (DCI Format 6-0A)

|  |  |
| --- | --- |
| Higher layer parameter'*pusch-maxNumRepetitionCEmodeA*' |  |
| Not configured | {1,2,4,8} |
| 16 | {1,4,8,16} |
| 32 | {1,4,16,32 } |

Table 8-2c: PUSCH repetition levels (DCI Format 6-0B)

|  |  |
| --- | --- |
| Higher layer parameter'*pusch-maxNumRepetitionCEmodeB*' |  |
| Not configured | {4,8,16,32,64,128,256,512} |
| 192  | {1,4,8,16,32,64,128,192} |
| 256  | {4,8,16,32,64,128,192,256}  |
| 384  | {4,16,32,64,128,192,256,384}  |
| 512  | {4,16,64,128,192,256,384,512}  |
| 768  | {8,32,128,192,256,384,512,768} |
| 1024  | {4,8,16,64,128,256,512,1024}  |
| 1536  | {4,16,64,256,512,768,1024,1536} |
| 2048  | {4,16,64,128,256,512,1024,2048} |

A UE configured with parameter *pusch-EnhancementsConfig* shall upon detection on a given serving cell of an PDCCH/EPDCCH with DCI Format 0C intended for the UE, perform a corresponding PUSCH transmission in subframe(s) *n+ki* if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8] with *i = 0, 1, …, N-1* according to the PDCCH/EPDCCH, where

- subframe *n* is the subframe in which the PDCCH/EPDCCH is transmitted; and

*- x≤k0<k1<…,kN-1* and the value of *N* is given by Table 8-2k based on the *repetition number* field in the corresponding DCI Format 0C; and

- in case *N>1*, subframe(s) *n+ki* with *i=0,1,…,N-1* are *N* consecutive UL subframe(s) starting with subframe *n+x*, and in case *N=1*, *k0=x*;

- for FDD, *x = 4*;

- for TDD UL/DL configurations 1-5 or for TDD UL/DL configuration 6 and a UE not configured with higher layer parameter *symPUSCH-UpPts-r14*, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; If the value x is not given in Table 8-2 for subframe *n*, denote subframe *n'* as the first downlink/special subframe which has a value in Table 8-2 after subframe *n*, and substitute *n* with *n'* in the above procedure for performing the PUSCH transmission.

- for TDD UL/DL configuration 0, if the MSB of the UL index in the PDCCH with DCI format 0C is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the PDCCH with DCI format 0C is set to 1, *x = 7.* The UE is not expected to receive DCI format 0C with both the MSB and LSB of the UL index set to 1 when *N>1*. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 0C

- for TDD UL/DL configuration 6 and a UE configured with higher layer parameter *symPUSCH-UpPTS-r14,* if the MSB of the UL index in the PDCCH with DCI format 0C is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the PDCCH with DCI format 0C is set to 1, *x = 6.* The UE is not expected to receive DCI format 0C with both the MSB and LSB of the UL index set to 1 when *N>1*. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 0C

Table 8-2k: PUSCH repetition levels (DCI Format 0C)

|  |  |
| --- | --- |
| Repetition Number field in DCI Format 0C | Number of repetitions *N* |
| 000 | 1 |
| 001 | 2 |
| 010 | 4 |
| 011 | 8 |
| 100 | 12 |
| 101 | 16 |
| 110 | 24 |
| 111 | 32 |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

For a serving cell that is a LAA SCell, a UE shall

- upon detection of an PDCCH/ EPDCCH with DCI format 0A/0B/4A/4B and with 'PUSCH trigger A' field set to '0' in subframe *n* intended for the UE, or

- upon detection of PDCCH/ EPDCCH with DCI format 0A/0B/4A/4B in subframe *n*-*p* with 'PUSCH trigger A' field set to '1' intended for the UE for the serving cell and that has not been triggered by a 'PUSCH trigger B' field set to '1' received prior to subframe *n* on the serving cell, with *p>=1* and *p<=v*, and upon detection of PDCCH with DCI CRC scrambled by CC-RNTI and with 'PUSCH trigger B' field set to '1' in subframe *n* on the serving cell

perform a corresponding PUSCH transmission, conditioned on the channel access procedures described in subclause 4.2.1 of [13], in subframe(s) *n+l+k+i* with *i = 0, 1, …, N-1* according to the PDCCH/EPDCCH and HARQ process ID , where

- *N* =1 for DCI format 0A/4A, and value of *N* is determined by the 'number of scheduled subframes' field in the corresponding DCI format 0B/4B.

- The UE is configured the maximum value of N by higher layer parameter *maxNumberOfSchedSubframes-Format0B* for DCI format 0B and higher layer parameter *maxNumberOfSchedSubframes-Format4B* for DCI format 4B;

- value of timing offset k is determined by the 'Timing offset' field in the corresponding DCI 0A/0B/4A/4B according to Table 8-2d if 'PUSCH trigger A' field set to '0' or Table 8-2e otherwise;

- value of is determined by the HARQ process number field in the corresponding DCI format 0A/0B/4A/4B and ;

*-* for 'PUSCH trigger A' field set to '0' in the corresponding DCI format 0A/0B/4A/4B,

*- l* = 3 if the UE is configured with higher layer parameter *shortProcessingTime,* and 4 otherwise

*-* otherwise

- value of *l* is the UL offset as determined by the 'UL duration and offset' field in the corresponding DCI with CRC scrambled by CC-RNTI according to the procedure in Subclause 13A, if 'PUSCH trigger B' field set to '1',

*-* value of validation duration *v* is determined by the 'Timing offset' field in the corresponding PDCCH/ EPDCCH with DCI format 0A/0B/4A/4B according to Table 8-2f

- the smallest value of *l+k* supported by the UE is included in the *UE-EUTRA-Capability*

- the value of *p+l+k* is at least 3 if the UE is configured with higher layer parameter *shortProcessingTime,* and 4 otherwise.

Table 8-2d: Timing offset for DCI format 0A/0B/4A/4B with 'PUSCH trigger A' field set to '0'.

|  |  |
| --- | --- |
| Value of 'Timing offset' field |  |
| 0000 | 0 |
| 0001 | 1 |
| 0010 | 2 |
| 0011 | 3 |
| 0100 | 4 |
| 0101 | 5 |
| 0110 | 6 |
| 0111 | 7 |
| 1000 | 8 |
| 1001 | 9 |
| 1010 | 10 |
| 1011 | 11 |
| 1100 | 12 |
| 1101 | 13 |
| 1110 | 14 |
| 1111 | 15 |

Table 8-2e: Timing offset for DCI format 0A/0B/4A/4B with 'PUSCH trigger A' field set to '1'.

|  |  |
| --- | --- |
| Value of the first two bits of'Timing offset' field |  |
| 00 | 0 |
| 01 | 1 |
| 10 | 2 |
| 11 | 3 |

Table 8-2f: Validation duration  for DCI format 0A/0B/4A/4B with 'PUSCH trigger A' field set to '1'.

|  |  |
| --- | --- |
| Value of the last two bits of'Timing offset' field |  |
| 00 | 8 |
| 01 | 12 |
| 10 | 16 |
| 11 | 20 |

For a serving cell that is an LAA SCell, a UE that is configured with autonomous uplink transmissions on the serving cell may perform a corresponding PUSCH transmission in subframe *n*, if the following conditions are met:

- subframe n is configured as usable for autonomous uplink transmission; and

- the UE has not received a grant according to DCI Format 0A/0B/4A/4B for transmission in subframe *n*; and

- autonomous uplink transmissions on the serving cell have been activated and not released according to the procedure described in subclause 9.2A; and

- subframe *n* is not in the DMTC window of the serving cell; and

- channel access procedures described in subclause 4.2.1 of [13] are followed to obtain channel access on the serving cell for subframe *n*.

- Additionally, if subframe *n* is a subframe in which the UE is not required to receive any downlink physical channels and/or physical signals according to clause 13A, then in order to perform a corresponding PUSCH transmission the UE shall have detected a PDCCH with DCI CRC scrambled by CC-RNTI indicating that subframe *n* is shared with the UE.

For an LAA serving cell where a UE is performing an autonomous uplink transmission in one or more contiguous subframe(s) on all  resource blocks, for the first such subframe the UE randomly determines a timing offset  to be applied for transmission according to [3] from a set of values configured by higher layers according to the following rule:

- If the first such subframe is a subframe in which the UE is not required to receive any downlink physical channels and/or physical signals, the set of values is determined by 30.72 \* *aul-startingFullBW-insideCOT*;

- otherwise, the set of values is determined by 30.72 \* *aul-startingFullBW-outsideCOT*.

-  is common for all carriers if more than one carrier is activated for autonomous uplink transmission.

For an LAA serving cell where a UE is performing an autonomous uplink transmission in one or more contiguous subframe(s) on fewer than  resource blocks, for the first such subframe the UE determines a timing offset  to be applied for transmission according to [3] according to the following rule:

- If the first such subframe is a subframe in which the UE is not required to receive any downlink physical channels and/or physical signals,  is equal to 30.72 \* *aul-startingPartialBW-insideCOT*;

- otherwise,  is equal to 30.72 \* *aul-startingPartialBW-outsideCOT*.

For a LAA SCell, a UE is not expected to receive more than one uplink scheduling grant for a subframe.

For a LAA SCell, the HARQ process ID shall be delivered to higher layers.

For a BL/CE UE, the HARQ process ID shall be delivered to higher layers.

If a UE is configured with higher layer parameter *shortTTI* or *shortProcessingTime*, the HARQ process ID shall be delivered to higher layers.

A UE is semi-statically configured via higher layer signalling to transmit PUSCH transmissions signalled via PDCCH/EPDCCH with DCI formats other than 7-0A/7-0B according to one of two uplink transmission modes, denoted mode 1 - 2. If a UE is configured with higher layer parameter *ul-STTI-Length*, the UE is semi-statically configured via higher layer signalling to transmit PUSCH transmissions signalled via PDCCH/SPDCCH with DCI formats 7-0A/7-0B according to one of two uplink transmission modes, denoted mode 1 - 2.

For a LAA SCell, the uplink transmission mode for autonomous uplink transmissions is configured independently from the uplink transmission mode for grant-based uplink transmissions. A UE is not expected to be configured with uplink transmission mode 2 for autonomous transmissions and uplink transmission mode 1 for grant-based uplink transmissions on the same LAA Scell.

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the PDCCH according to the combination defined in Table 8-3 and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. The scrambling initialization of this PUSCH corresponding to these PDCCHs and the PUSCH retransmission for the same transport block is by C-RNTI.

If a UE is configured by higher layers to decode EPDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the EPDCCH according to the combination defined in Table 8-3A and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. The scrambling initialization of this PUSCH corresponding to these EPDCCHs and the PUSCH retransmission for the same transport block is by C-RNTI.

If a UE is configured with higher layer parameter *shortTTI* and the UE is configured by higher layers to decode SPDCCH with the CRC scrambled by the C-RNTI, the UE shall decode the SPDCCH according to the combination defined in Table 8-3C and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. The scrambling initialization of this PUSCH corresponding to these SPDCCHs and the PUSCH retransmission for the same transport block is by C-RNTI.

If a UE is configured with a higher layer parameter *pusch-EnhancementsConfig*, the UE shall decode PDCCH/EPDCCH DCI format 0C in UE specific search space. In this case the UE is not required to decode/monitor DCI format 0 in the UE specific search space.

If a UE is configured with a higher layer parameter *shortTTI*, the UE shall decode PDCCH DCI format 7-0A/7-0B in UE specific search space.

If a UE is configured with a higher layer parameter *pusch-EnhancementsConfig*, the UE may assume that PDCCH/EPDCCH for a PUSCH retransmission of a transport block will occur in the UE specific search space if the PDCCH/EPDCCH for the corresponding initial PUSCH transmission for the same transport block was decoded in the UE specific search space.

If a UE is configured with a higher layer parameter *pusch-EnhancementsConfig*, the UE may assume that PDCCH/EPDCCH for a PUSCH retransmission of a transport block will occur in the common search space if the PDCCH/EPDCCH for the corresponding initial PUSCH transmission for the same transport block was decoded in the common search space.

If a UE is configured with higher layer parameter *pusch-EnhancementsConfig*, and the UE decodes a DCI format 0 in the common search space, the UE shall calculate the HARQ ID $n\_{HARQ} $for the corresponding PUSCH transmission in subframe $\left⌊\frac{n\_{s}}{2}\right⌋ $and radio frame $n\_{f}$ as:

* For a transmission in a normal uplink subframe, $n\_{HARQ}=\left(x\_{HARQ}\left(\left⌊\frac{n\_{s}}{2}\right⌋\right)+(x\_{MAX}+1)×n\_{f}\right)mod M\_{HARQ}$, where
	+ For FDD, $x\_{HARQ}\left(n\right)=n$, and $x\_{max}=9$
	+ For TDD, $x\_{HARQ}\left(n\right)$ is given by Table 8-2q, and $x\_{MAX}=max\left\{x\_{HARQ}\left(n\right)\right\}$.
	+ $M\_{HARQ}$ is the number of HARQ processes, which is $M\_{HARQ}=8$ for FDD, and given by the “Normal HARQ operation” column in table 8-1, in the case of TDD.
* For a transmission in a special subframe, $n\_{HARQ}=M\_{HARQ}$ if the transmission happens in the first special subframe of the radio frame, and $n\_{HARQ}=M\_{HARQ}+1$ otherwise.

Table 8-2q: $x\_{HARQ}$ for TDD

|  |  |
| --- | --- |
| TDD UL/DLConfiguration | subframe number *n* |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 |  |  | 0 | 1 | 2 |  |  | 3 | 4 | 5 |
| 1 |  |  | 0 | 1 |  |  |  | 2 | 3 |  |
| 2 |  |  | 0 |  |  |  |  | 1 |  |  |
| 3 |  |  | 0 | 1 | 2 |  |  |  |  |  |
| 4 |  |  | 0 | 1 |  |  |  |  |  |  |
| 5 |  |  | 0 |  |  |  |  |  |  |  |
| 6 |  |  | 0 | 1 | 2 |  |  | 3 | 4 |  |

The UE may for handover purposes, and before acquiring the SFN at the target cell, assume an absolute value of the relative time difference between radio frame  in the current cell and the target cell of less than  when determining $n\_{HARQ}$.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the MPDCCH according to the combination defined in Table 8-3B and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8]. The scrambling initialization of this PUSCH corresponding to these MPDCCHs and the PUSCH retransmission for the same transport block is by C-RNTI.

Transmission mode 1 is the default uplink transmission mode for a UE until the UE is assigned an uplink transmission mode by higher layer signalling.

When a UE configured in transmission mode 2 receives a DCI Format 0/0A/0B/0C uplink scheduling grant, it shall assume that the PUSCH transmission is associated with transport block 1 and that transport block 2 is disabled.

Table 8-3: PDCCH and PUSCH configured by C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to PDCCH |
| Mode 1 | DCI format 0 | Common andUE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| DCI format 0A or 0B or 0C or 7-0A | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| Mode 2 | DCI format 0 | Common andUE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| DCI format 0A or 0B or 0C | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| DCI format 4 or 4A or 4B or 7-0B | UE specific by C-RNTI | Closed-loop spatial multiplexing (see Subclause 8.0.2) |

Table 8-3A: EPDCCH and PUSCH configured by C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to EPDCCH |
| Mode 1 | DCI format 0 or 0A or 0B or 0C | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| Mode 2 | DCI format 0 or 0A or 0B or 0C | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| DCI format 4 or 4A or 4B | UE specific by C-RNTI | Closed-loop spatial multiplexing (see Subclause 8.0.2) |

Table 8-3B: MPDCCH and PUSCH configured by C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to MPDCCH |
| Mode 1 | DCI format 6-0A or 6-0B | Type0-common (only for 6-0A) and UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |

Table 8-3C: SPDCCH and PUSCH configured by C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to SPDCCH |
| Mode 1 | DCI format 7-0A | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| Mode 2 | DCI format 7-0B | UE specific by C-RNTI | Closed-loop spatial multiplexing (see Subclause 8.0.2) |

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the C-RNTI and is also configured to receive random access procedures initiated by "PDCCH orders", the UE shall decode the PDCCH according to the combination defined in Table 8-4.

If a UE is configured by higher layers to decode EPDCCHs with the CRC scrambled by the C-RNTI and is also configured to receive random access procedures initiated by "PDCCH orders", the UE shall decode the EPDCCH according to the combination defined in Table 8-4A.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the C-RNTI and is also configured to receive random access procedures initiated by "PDCCH orders", the UE shall decode the MPDCCH according to the combination defined in Table 8-4B.

Table 8-4: PDCCH configured as "PDCCH order" to initiate random access procedure

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 1A | Common andUE specific by C-RNTI |

Table 8-4A: EPDCCH configured as "PDCCH order" to initiate random access procedure

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 1A | UE specific by C-RNTI |

Table 8-4B: MPDCCH configured as "PDCCH order" to initiate random access procedure

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 6-1A or 6-1B | Type0-common (only for 6-1A) and UE specific by C-RNTI |

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the SPS C-RNTI or UL-SPS-V-RNTI, the UE shall decode the PDCCH according to the combination defined in Table 8-5 and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8] except when the UE is configured with higher layer parameter *shortProcessingTime* and with DCI format 0 mapped onto the UE-specific search space.
The scrambling initialization of this PUSCH corresponding to these PDCCHs and PUSCH retransmission for the same transport block is by SPS C-RNTI or UL-SPS-V-RNTI. The scrambling initialization of initial transmission of this PUSCH without a corresponding PDCCH and the PUSCH retransmission for the same transport block is by SPS C-RNTI or UL-SPS-V-RNTI.

If a UE is configured by higher layers to decode EPDCCHs with the CRC scrambled by the SPS C-RNTI or UL-SPS-V-RNTI, the UE shall decode the EPDCCH according to the combination defined in Table 8-5A and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8].
The scrambling initialization of this PUSCH corresponding to these EPDCCHs and PUSCH retransmission for the same transport block is by SPS C-RNTI or UL-SPS-V-RNTI. The scrambling initialization of initial transmission of this PUSCH without a corresponding EPDCCH and the PUSCH retransmission for the same transport block is by SPS C-RNTI or UL-SPS-V-RNTI.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the SPS C-RNTI, the UE shall decode the MPDCCH according to the combination defined in Table 8-5B and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8].
The scrambling initialization of this PUSCH corresponding to these MPDCCHs and PUSCH retransmission for the same transport block is by SPS C-RNTI. The scrambling initialization of initial transmission of this PUSCH without a corresponding MPDCCH and the PUSCH retransmission for the same transport block is by SPS C-RNTI.

If a UE is configured by higher layers to decode SPDCCHs with the CRC scrambled by the SPS C-RNTI, the UE shall decode the SPDCCH according to the combination defined in Table 8-5C and transmit the corresponding PUSCH if a transport block corresponding to the HARQ process of the PUSCH transmission is generated as described in [8].
The scrambling initialization of this PUSCH corresponding to these SPDCCHs and PUSCH retransmission for the same transport block is by SPS C-RNTI. The scrambling initialization of initial transmission of this PUSCH without a corresponding SPDCCH and the PUSCH retransmission for the same transport block is by SPS C-RNTI.

Table 8-5: PDCCH and PUSCH configured by SPS C-RNTI or UL-SPS-V-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to PDCCH |
| Mode 1 | DCI format 0 | Common andUE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| DCI format 7-0A | UE specific by C-RNTI |
| Mode 2 | DCI format 0 | Common andUE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| DCI format 7-0B | UE specific by C-RNTI |

Table 8-5A: EPDCCH and PUSCH configured by SPS C-RNTI or UL-SPS-V-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to PDCCH |
| Mode 1 | DCI format 0 | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| Mode 2 | DCI format 0 | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |

Table 8-5B: MPDCCH and PUSCH configured by SPS C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to PDCCH |
| Mode 1 | DCI format 6-0A | Type0-common (only for 6-0A) and UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |

Table 8-5C: SPDCCH and PUSCH configured by SPS C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to SPDCCH |
| Mode 1 | DCI format 7-0A | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| Mode 2 | DCI format 7-0B | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the Temporary C-RNTI regardless of whether UE is configured or not configured to decode PDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the PDCCH according to the combination defined in Table 8-6 and transmit the corresponding PUSCH. The scrambling initialization of PUSCH corresponding to these PDCCH is by Temporary C-RNTI.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the Temporary C-RNTI regardless of whether UE is configured or not configured to decode MPDCCHs with the CRC scrambled by the C-RNTI during random access procedure, the UE shall decode the MPDCCH according to the combination defined in Table 8-6A and transmit the corresponding PUSCH. The scrambling initialization of PUSCH corresponding to these MPDCCH is by Temporary C-RNTI.

If a Temporary C-RNTI is set by higher layers, the scrambling of PUSCH corresponding to the Random Access Response Grant in Subclause 6.2 and the PUSCH retransmission for the same transport block is by Temporary C-RNTI. Else, the scrambling of PUSCH corresponding to the Random Access Response Grant in Subclause 6.2 and the PUSCH retransmission for the same transport block is by C-RNTI.

If a UE is also configured by higher layers to decode MPDCCH with CRC scrambled by the C-RNTI during random access procedure, the UE shall decode the MPDCCH according to the combination defined in Table 8-6A and transmit the corresponding PUSCH. The scrambling initialization of PUSCH corresponding to these MPDCCH is by C-RNTI.

Table 8-6: PDCCH configured by Temporary C-RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 0 | Common |

Table 8-6A: MPDCCH configured by Temporary C-RNTI and/or C-RNTI during random access procedure

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 6-0A, 6-0B | Type2-Common |

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the TPC-PUCCH-RNTI, the UE shall decode the PDCCH according to the combination defined in table 8-7. The notation 3/3A implies that the UE shall receive either DCI format 3 or DCI format 3A depending on the configuration.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the TPC-PUCCH-RNTI, the UE shall decode the MPDCCH according to the combination defined in table 8-7A. The notation 3/3A implies that the UE shall receive either DCI format 3 or DCI format 3A depending on the configuration.

Table 8-7: PDCCH configured by TPC-PUCCH-RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 3/3A | Common |

Table 8-7A: MPDCCH configured by TPC-PUCCH-RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 3/3A | Type0-Common (for CEModeA only) |

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the TPC-PUSCH-RNTI, the UE shall decode the PDCCH according to the combination defined in table 8.8. The notation 3/3A implies that the UE shall receive either DCI format 3 or DCI format 3A depending on the configuration.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the TPC-PUSCH-RNTI, the UE shall decode the MPDCCH according to the combination defined in table 8.8A. The notation 3/3A implies that the UE shall receive either DCI format 3 or DCI format 3A depending on the configuration.

Table 8-8: PDCCH configured by TPC-PUSCH-RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 3/3A | Common |

Table 8-8A: MPDCCH configured by TPC-PUSCH-RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 3/3A | Type0-Common (for CEModeA only) |

If the UE is configured by higher layers to decode PDCCHs with the CRC scrambled by higher layer parameter *srs-TPC-RNTI-r14*, the UE shall decode the PDCCH according to the combination defined in Table 8-8B.

Table 8-8B: PDCCH configured by higher layer parameter *srs-TPC-RNTI-r14*

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format 3B | Common |

If a UE is configured by higher layers to decode PDCCHs/EPDCCHs with the CRC scrambled by the AUL C-RNTI, the UE shall decode the PDCCH/EPDCCH according to the combination defined in Table 8-9.

Table 8-9: PDCCH/EPDCCH configured by AUL C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Autonomous uplinkTransmission mode | DCI format | Search Space | Transmission scheme of correspondingautonomous PUSCH |
| Mode 1 | DCI format 0A | UE specific by C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |
| Mode 2 | DCI format 4A | UE specific by C-RNTI | Closed-loop spatial multiplexing (see Subclause 8.0.2) |

A UE may transmit PUSCH on preconfigured uplink resources as configured by higher layers. The scrambling initialization of PUSCH transmission using preconfigured uplink resource is by PUR C-RNTI.

If a UE is configured by higher layers to decode MPDCCHs with the CRC scrambled by the PUR C-RNTI, the UE shall decode the MPDCCH according to the combination defined in Table 8-10 and in case the indication in the DCI corresponds to the retransmission of a transport block transmitted using preconfigured uplink resource, transmit a corresponding PUSCH. The scrambling initialization of this PUSCH corresponding to these MPDCCHs and the PUSCH retransmission for the same transport block is by PUR C-RNTI.

Table 8-10: MPDCCH and PUSCH configured by PUR C-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
| Transmission mode | DCI format | Search Space | Transmission scheme of PUSCH corresponding to MPDCCH |
| Mode 1 | DCI format 6-0A or 6-0B | UE specific by PUR C-RNTI | Single-antenna port, port 10 (see Subclause 8.0.1) |