

## CHANGE REQUEST

36.213 CR 0709 rev - Current version: 13.2.0

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<http://www.3gpp.org/Change-Requests>.

Proposed change affects: UICC apps ☐ ME ☒ Radio Access Network ☒ Core Network ☐

|                        |                                                                                                |              |                      |
|------------------------|------------------------------------------------------------------------------------------------|--------------|----------------------|
| <b>Title:</b>          | Addition of LTE_LATRED_L2-Core                                                                 |              |                      |
| <b>Source to WG:</b>   | Ericsson                                                                                       |              |                      |
| <b>Source to TSG:</b>  |                                                                                                |              |                      |
| <b>Work item code:</b> | LTE_LATRED_L2-Core                                                                             | <b>Date:</b> | 2016-08-12           |
| <b>Category:</b>       | <b>B</b>                                                                                       |              |                      |
|                        | Use <u>one</u> of the following categories:                                                    |              |                      |
|                        | <b>F</b> (correction)                                                                          |              | <b>Release:</b> Rel- |
|                        | <b>A</b> (mirror corresponding to a change in an earlier release)                              |              | Rel-8 (Release 8)    |
|                        | <b>B</b> (addition of feature).                                                                |              | Rel-9 (Release 9)    |
|                        | <b>C</b> (functional modification of feature)                                                  |              | Rel-10 (Release 10)  |
|                        | <b>D</b> (editorial modification)                                                              |              | Rel-11 (Release 11)  |
|                        | Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> . |              | Rel-12 (Release 12)  |
|                        |                                                                                                |              | Rel-13 (Release 13)  |
|                        |                                                                                                |              | Rel-14 (Release 14)  |

|                                      |                                                                                                                |  |  |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------|--|--|
| <b>Reason for change:</b>            | Adding LTE_LATRED_L2-Core to specification                                                                     |  |  |
| <b>Summary of change:</b>            | Add that PUSCH is not transmitted if not high layers generates a MAC entity for the corresponding HARQ process |  |  |
| <b>Consequences if not approved:</b> | LTE_LATRED_L2-Core is not supported                                                                            |  |  |

|                              |                                                                                                                                  |                     |   |   |  |  |   |  |   |                           |                |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------|---|---|--|--|---|--|---|---------------------------|----------------|
| <b>Clauses affected:</b>     | 8.0, 16.5.1                                                                                                                      |                     |   |   |  |  |   |  |   |                           |                |
| <b>Other specs affected:</b> | <table><tr><td>Y</td><td>N</td></tr><tr><td>X</td><td></td></tr><tr><td></td><td>X</td></tr><tr><td></td><td>X</td></tr></table> | Y                   | N | X |  |  | X |  | X | Other core specifications | 36.321, 36.300 |
| Y                            | N                                                                                                                                |                     |   |   |  |  |   |  |   |                           |                |
| X                            |                                                                                                                                  |                     |   |   |  |  |   |  |   |                           |                |
|                              | X                                                                                                                                |                     |   |   |  |  |   |  |   |                           |                |
|                              | X                                                                                                                                |                     |   |   |  |  |   |  |   |                           |                |
| <b>(show related CRs)</b>    |                                                                                                                                  | Test specifications |   |   |  |  |   |  |   |                           |                |
|                              |                                                                                                                                  | O&M Specifications  |   |   |  |  |   |  |   |                           |                |
| <b>Other comments:</b>       |                                                                                                                                  |                     |   |   |  |  |   |  |   |                           |                |

## 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.

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, ~~adjust the corresponding PUSCH transmission in subframe  $n+4$  according to the PDCCH/EPDCCH and PHICH information; transmit a corresponding PUSCH in subframe  $n+4$  according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH.~~

For FDD-TDD and normal HARQ operation and a PUSCH for serving cell  $c$  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, ~~transmit a corresponding PUSCH in subframe  $n+4$  for serving cell  $c$  according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH; adjust the corresponding PUSCH transmission for serving cell  $c$  in subframe  $n+4$  according to the PDCCH/EPDCCH and PHICH information.~~

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 adjust 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 adjust 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 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, when simultaneous PUSCH and PUCCH transmission is not configured for the UE.

For FDD-TDD and normal HARQ operation, for a serving cell with frame structure type 1, if a PDCCH/EPDCCH 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, when simultaneous PUSCH and PUCCH transmission is not configured for the UE.

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 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 where  $k$  is given by Table 8-2, when simultaneous PUSCH and PUCCH transmission is not configured for the UE.

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, adjust the corresponding first PUSCH transmission in the bundle in subframe  $n+4$  according to the PDCCH/EPDCCH and PHICH information transmit a corresponding first PUSCH in the bundled in subframe  $n+4$  according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process.

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, transmit a corresponding first PUSCH in the bundled in subframe  $n+4$  according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process~~adjust the corresponding first PUSCH transmission in the bundle in subframe  $n+4$  according to the PDCCH/EPDCCH and PHICH information.~~

For both FDD and TDD serving cells, the NDI as signalled on PDCCH/EPDCCH, 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.

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. For TDD and transmission mode 2, 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]) as indicated in Table 8-1 and 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 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 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 2 uplink HARQ processes per serving cell.

**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                                                        |

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, the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format and/or a PHICH transmission in subframe  $n$  intended for the UE, transmit a corresponding PUSCH in subframe  $n+k$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause

~~8.6.2 is indicated in the PDCCH/EPDCCH, adjust the corresponding PUSCH transmission in subframe  $n+k$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and PHICH information.~~

- For TDD UL/DL configuration 0 and normal HARQ operation the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format and/or a PHICH transmission in subframe  $n$  intended for the UE, ~~transmit a corresponding PUSCH in subframe  $n+k$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH and adjust the corresponding PUSCH transmission in subframe  $n+k$~~  if the MSB of the UL index in the PDCCH/EPDCCH with uplink DCI format is set to 1 or PHICH is received in subframe  $n=0$  or 5 in the resource corresponding to  $I_{PHICH} = 0$ , as defined in subclause 9.1.2, with  $k$  given in Table 8-2. 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  $I_{PHICH} = 1$ , as defined in subclause 9.1.2, or PHICH is received in subframe  $n=1$  or 6, ~~transmit a corresponding PUSCH in subframe  $n+7$  according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH. the UE shall adjust the corresponding PUSCH transmission in subframe  $n+7$ .~~ If, for TDD UL/DL configuration 0, both the MSB and LSB of the UL index in the PDCCH/EPDCCH with uplink DCI format are set in subframe  $n$ , ~~transmit a corresponding PUSCH in subframe  $n+k$  and  $n+7$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH. the UE shall adjust the corresponding PUSCH transmission in both subframes  $n+k$  and  $n+7$ , with  $k$  given in Table 8-2.~~

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, the UE shall upon detection of a PDCCH/EPDCCH with uplink DCI format and/or a PHICH transmission in subframe  $n$  intended for the UE, ~~transmit a corresponding PUSCH in subframe  $n+k$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH, where the "TDD UL/DL Configuration" given in Table 8-2 refers to the UL-reference UL/DL configuration. adjust the corresponding PUSCH transmission in subframe  $n+k$  for the serving cell, with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and PHICH information, 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 and/or a PHICH transmission in subframe  $n$  intended for the UE, ~~transmit a corresponding PUSCH in subframe  $n+k$  for the serving cell  $c$ , according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH. adjust the corresponding PUSCH transmission in subframe  $n+k$  for the serving cell~~ if the MSB of the UL index in the PDCCH/EPDCCH with uplink DCI format is set to 1 or PHICH is received in subframe  $n=0$  or 5 in the resource corresponding to  $I_{PHICH} = 0$ , as defined in subclause 9.1.2, with  $k$  given in Table 8-2. 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  $I_{PHICH} = 1$ , as defined in subclause 9.1.2, or PHICH is received in subframe  $n=1$  or 6, ~~transmit a corresponding PUSCH in subframe  $n+7$  according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH. the UE shall adjust the corresponding PUSCH transmission in subframe  $n+7$  for the serving cell.~~ 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 are set in subframe  $n$ , ~~transmit a corresponding PUSCH in subframe  $n+k$  and  $n+7$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH. the UE shall adjust the corresponding PUSCH transmission in both subframes  $n+k$  and  $n+7$ .~~

~~$n+7$  for the serving cell, with  $k$  given in Table 8-2, where the TDD UL/DL Configuration" given in Table 8-2 refers to the UL-reference UL/DL configuration.~~

For TDD UL/DL configurations 1 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, ~~transmit a corresponding first PUSCH in the bundle in subframe  $n+k$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and/or PHICH information if a MAC PDU has been delivered by higher layer for the corresponding HARQ process~~ adjust the corresponding first PUSCH transmission in the bundle in subframe  $n+k$ , with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and PHICH information.

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, ~~if a MAC PDU has been delivered by higher layer for the corresponding HARQ process, transmit and~~ adjust the corresponding first PUSCH transmission in the bundle in subframe  $n+k$ , if the MSB of the UL index in the DCI format 0 is set to 1 or if  $I_{PHICH} = 0$ , as defined in subclause 9.1.2, with  $k$  given in Table 8-2, according to the PDCCH/EPDCCH and PHICH information. 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  $I_{PHICH} = 1$ , as defined in subclause 9.1.2, ~~if a MAC PDU has been delivered by higher layer for the corresponding HARQ process~~ the UE shall transmit ~~adjust~~ the corresponding first PUSCH transmission in the bundle in subframe  $n+7$ , according to the PDCCH/EPDCCH and PHICH information.

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

| TDD UL/DL Configuration | 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 and 6**

| TDD UL/DL Configuration | subframe number $n$ |   |   |   |   |   |   |   |   |   |
|-------------------------|---------------------|---|---|---|---|---|---|---|---|---|
|                         | 0                   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0                       | 9                   | 6 |   |   |   | 9 | 6 |   |   |   |
| 1                       |                     | 2 |   |   | 3 |   | 2 |   |   | 3 |
| 6                       | 5                   | 5 |   |   |   | 6 | 6 |   |   | 8 |

For BL/CE UEs configured with higher layer parameter *fdd-UplinkSubframeBitmapBR* or *fdd-DownlinkOrTddSubframeBitmapBR*, the higher layer parameter indicates the set of BL/CE UL subframes. For BL/CE UEs not configured with higher layer parameter *fdd-UplinkSubframeBitmapBR* or *fdd-DownlinkOrTddSubframeBitmapBR*, all UL subframes are considered as BL/CE UL subframes.

A BL/CE UE shall upon detection on a given serving cell of an MPDCCH with DCI format 6-0A/6-0B intended for the UE, ~~if a MAC PDU has been delivered by higher layer for the corresponding HARQ process~~ transmit ~~adjust~~ the corresponding PUSCH transmission in subframe(s)  $n+k_i$  with  $i = 0, 1, \dots, N-1$  according to the MPDCCH, where

- subframe  $n$  is the last subframe in which the MPDCCH is transmitted; and
- $x \leq k_0 < k_1 < \dots, k_{N-1}$  and the value of  $N \in \{n1, n2, \dots, n_{\max}\}$  is determined by the *repetition number* field in the corresponding DCI, where  $n1, n2, \dots, n_{\max}$  are given in Table 8-2b and Table 8-2c; and
- in case  $N > 1$ , subframe(s)  $n+k_i$  with  $i=0, 1, \dots, N-1$  are  $N$  consecutive BL/CE UL subframe(s) starting with subframe  $n+x$ , and in case  $N=1$ ,  $k_0=x$ ;

- 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  $x$  is given 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 adjusting the PUSCH transmission.
- for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA and  $N=1$ , if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of  $x$  is given 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  $n_{\text{HARQ\_ID}}$  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is  $(n_{\text{HARQ\_ID}} + 1) \bmod 7$ , where  $n_{\text{HARQ\_ID}}$  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.

**Table 8.2b: PUSCH repetition levels (DCI Format 6-0A)**

| Higher layer parameter<br>'pusch-maxNumRepetitionCEmodeA' | $\{n1, n2, n3, n4\}$ |
|-----------------------------------------------------------|----------------------|
| 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<br>'pusch-maxNumRepetitionCEmodeB' | $\{n1, n2, \dots, n8\}$         |
|-----------------------------------------------------------|---------------------------------|
| 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 is semi-statically configured via higher layer signalling to transmit PUSCH transmissions signalled via PDCCH/EPDCCH according to one of two uplink transmission modes, denoted mode 1 - 2.

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 a corresponding PUSCH if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block.

~~associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH~~ ~~transmit the corresponding PUSCH~~. 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 a corresponding PUSCH if a MAC PDU has been delivered by higher layer for the corresponding HARQ process or aperiodic CSI report with no transport block associated as defined in subclause 8.6.2 is indicated in the PDCCH/EPDCCH~~ ~~transmit the corresponding PUSCH~~. 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 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 ~~if a MAC PDU has been delivered by higher layer for the corresponding HARQ process~~ transmit the corresponding PUSCH. 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 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 and UE specific by C-RNTI | Single-antenna port, port 10 (see subclause 8.0.1)     |
| Mode 2            | DCI format 0 | Common and UE specific by C-RNTI | Single-antenna port, port 10 (see subclause 8.0.1)     |
|                   | DCI format 4 | 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 | 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)     |
|                   | DCI format 4 | 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)   |

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 and UE 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, the UE shall decode the PDCCH according to the combination defined in Table 8-5 and transmit a corresponding PUSCH if a MAC PDU has been delivered by higher layer for the corresponding HARQ process ~~transmit the corresponding PUSCH~~. The scrambling initialization of this PUSCH corresponding to these PDCCHs 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 PDCCH and the PUSCH retransmission for the same transport block is by SPS C-RNTI.

If a UE is configured by higher layers to decode EPDCCHs with the CRC scrambled by the SPS C-RNTI, the UE shall decode the EPDCCH according to the combination defined in Table 8-5A and transmit a corresponding PUSCH if a MAC PDU has been delivered by higher layer for the corresponding HARQ process ~~transmit the corresponding PUSCH~~.

The scrambling initialization of this PUSCH corresponding to these EPDCCHs 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 EPDCCH and the PUSCH retransmission for the same transport block is by SPS C-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 a corresponding PUSCH if a MAC PDU has been delivered by higher layer for the corresponding HARQ process ~~transmit the corresponding PUSCH~~.

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.

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

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

**Table 8-5A: EPDCCH and PUSCH configured by SPS C-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)  |

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) |

### 16.5.1 UE procedure for transmitting format 1 narrowband physical uplink shared channel

A UE shall upon detection on a given serving cell of a NPDCCH with DCI format N0 ending in NB-IoT DL subframe  $n$  intended for the UE and if a MAC PDU has been delivered by higher layer, adjust, at the end of  $n+k_0$  DL subframe, the corresponding NPUSCH transmission using NPUSCH format 1 in  $N$  consecutive NB-IoT UL slots  $n_i$  with  $i = 0, 1, \dots, N-1$  according to the NPDCCH information where

- subframe  $n$  is the last subframe in which the NPDCCH is transmitted and is determined from the starting subframe of NPDCCH transmission and the DCI subframe repetition number field in the corresponding DCI; and
- $N = N_{\text{Rep}} N_{\text{RU}} N_{\text{slots}}^{\text{UL}}$ , where the value of  $N_{\text{Rep}}$  is determined by the repetition number field in the corresponding DCI (see subclause 16.5.1.1), the value of  $N_{\text{RU}}$  is determined by the resource assignment field in the corresponding DCI (see subclause 16.5.1.1), and the value of  $N_{\text{slots}}^{\text{UL}}$  is the number of NB-IoT UL slots of the resource unit (defined in clause 10.1.2.3 of [3]) corresponding to the allocated number of subcarriers (as determined in subclause 16.5.1.1) in the corresponding DCI,
- value of  $k_0$  is determined by the scheduling delay field ( $I_{\text{Delay}}$ ) in the corresponding DCI according to Table 16.5.1-1.

**Table 16.5.1-1:  $k_0$  for DCI format N0.**

| $I_{\text{Delay}}$ | $k_0$ |
|--------------------|-------|
| 0                  | 8     |
| 1                  | 16    |
| 2                  | 32    |
| 3                  | 64    |

If a UE is configured by higher layers to decode NPDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the NPDCCH according to the combination defined in Table 16.5.1-2 and transmit a corresponding NPUSCH if a MAC PDU has been delivered by higher layer~~transmit the corresponding NPUSCH~~. The scrambling initialization of this NPUSCH corresponding to these NPDCCHs and the NPUSCH retransmission for the same transport block is by C-RNTI.

**Table 16.5.1-2: NPDCCH and PUSCH configured by C-RNTI**

| DCI format    | Search Space          |
|---------------|-----------------------|
| DCI format N0 | UE specific by C-RNTI |

If a UE is configured to receive random access procedures initiated by "PDCCH orders", the UE shall decode the NPDCCH according to the combination defined in Table 16.5.1-3.

**Table 16.5.1-3: NPDCCH configured as "PDCCH order" to initiate random access procedure**

| DCI format    | Search Space          |
|---------------|-----------------------|
| DCI format N1 | UE specific by C-RNTI |

If a UE is configured by higher layers to decode NPDCCHs with the CRC scrambled by the Temporary C-RNTI regardless of whether UE is configured or not configured to decode NPDCCH with the CRC scrambled by the C-RNTI, the UE shall decode the NPDCCH according to the combination defined in Table 16.5.1-4 and transmit the corresponding NPUSCH. The scrambling initialization of NPUSCH corresponding to these NPDCCHs is by Temporary C-RNTI.

If a Temporary C-RNTI is set by higher layers, the scrambling initialization of NPUSCH corresponding to the Narrowband Random Access Response Grant in subclause 16.3.3 and any NPUSCH retransmission(s) for the same transport block is by Temporary C-RNTI. Otherwise, the scrambling initialization of NPUSCH corresponding to the Narrowband Random Access Response Grant in subclause 16.3.3 and any NPUSCH retransmission(s) for the same transport block is by C-RNTI.

Table 16.5.1-4: NPDCCH and PUSCH configured by Temporary C-RNTI

| DCI format    | Search Space  |
|---------------|---------------|
| DCI format N0 | Type-2 Common |