**3GPP TSG- Meeting #**

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| *CR-Form-v12.1* |
| **DRAFT CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
|  |
| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  |  |
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| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** | 2021-11-01 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | Introduction of additional enhancements for LTE-MTC. |
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| ***Summary of change:*** | Support for LTE-MTC features according to RAN1 agreements:- Additional PDSCH and HARQ-ACK scheduling delay for introduction of 14-HARQ processes in DL, for HD-FDD Cat M1 UEs  |
|  |  |
| ***Consequences if not approved:*** | No support of additional enhancements for LTE-MTC. |
|  |  |
| ***Clauses affected:*** | 10.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **x** |  |  Other core specifications  | TS 36.211, TS 36.212 |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Unchanged parts are omitted>

## 10.2 Uplink HARQ-ACK timing

For TDD or for FDD-TDD and primary cell frame structure type 2 or for FDD-TDD and primary cell frame structure type 1, if a UE configured with *EIMTA-MainConfigServCell-r12* for a serving cell, "UL/DL configuration" of the serving cell in Clause 10.2 refers to the UL/DL configuration given by the parameter *eimta-HARQ-ReferenceConfig-r12* for the serving cell unless specified otherwise.

For TDD serving cell not configured for PUSCH/PUCCH transmission, "UL/DL configuration" of the serving cell in Clause 10.2 refers to the UL/DL configuration given by the parameter *harq-ReferenceConfig-r14* for the serving cell unless specified otherwise

For a non-BL/CE UE, for FDD or for FDD-TDD and primary cell frame structure type 1, the UE shall upon detection of a PDSCH transmission in subframe *n-4* intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response in subframe *n*. If HARQ-ACK repetition is enabled, upon detection of a PDSCH transmission in subframe *n-4* intended for the UE and for which HARQ-ACK response shall be provided, and if the UE is not repeating the transmission of any HARQ-ACK in subframe  corresponding to a PDSCH transmission in subframes , … , , the UE:

- shall transmit only the HARQ-ACK response (corresponding to the detected PDSCH transmission in subframe ) on PUCCH in subframes , , …, ;

- shall not transmit any other signal/channel in subframes , , …, ; and

- shall not transmit any HARQ-ACK response repetitions corresponding to any detected PDSCH transmission in subframes , …, .

For TDD and a UE configured with *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, the DL-reference UL/DL configuration for a serving cell is the UL/DL configuration of the serving cell.

For FDD-TDD and primary cell frame structure type 1, if a serving cell is a secondary serving cell with frame structure type 2, the DL-reference UL/DL configuration for the serving cell is the UL/DL configuration of the serving cell.

For TDD, if the UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations and if a serving cell is a primary cell, then the primary cell UL/DL configuration is the DL-reference UL/DL configuration for the serving cell.

For FDD-TDD and primary cell frame structure type 2, if a serving cell is a primary cell or if a serving cell is a secondary cell with frame structure type 1, then the primary cell UL/DL configuration is the DL-reference UL/DL configuration for the serving cell.

For TDD and if the UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations and if the UE is not configured with *harqTimingTDD = TRUE* and if a serving cell is a secondary cell, or for FDD-TDD and primary cell frame structure type 2 and if the UE is not configured with *harqTimingTDD = TRUE* and if a serving cell is a secondary cell with frame structure type 2

- if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration ) belongs to Set 1 in Table 10.2-1 or

- if the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, and if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration ) belongs to Set 2 or Set 3 in Table 10.2-1 or

- if the UE is configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, and if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration) belongs to Set 4 or Set 5 in Table 10.2-1

then the DL-reference UL/DL configuration for the serving cell is defined in the corresponding Set in Table 10.2-1.

For TDD and if the UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations and if the UE is configured with *harqTimingTDD = TRUE* and if a serving cell is a secondary cell, or for FDD-TDD and primary cell frame structure type 2 and if the UE is configured with *harqTimingTDD = TRUE* and if a serving cell is a secondary cell with frame structure type 2

- if the UE is configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, and if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration) belongs to Set 1 or Set 4 or Set 5 in Table 10.2-1, then the DL-reference UL/DL configuration for the serving cell is defined in the corresponding Set in Table 10.2-1;

- if the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, and then the primary cell UL/DL configuration is the DL-reference UL/DL configuration for the serving cell.

For a UE not configured with PUCCH format 4 or PUCCH format 5, for TDD and if a UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations or for FDD-TDD and primary cell frame structure type 2, if the DL-reference UL/DL configuration for at least one serving cell is TDD UL/DL Configuration 5, then the UE is not expected to be configured with more than two serving cells.

For TDD and a non-BL/CE UE not configured with *EIMTA-MainConfigServCell-r12* for any serving cell, if the UE is configured with one serving cell, or the UE is configured with more than one serving cell and the UL/DL configurations of all serving cells is same, then the UE shall upon detection of a PDSCH transmission within subframe(s) , where  and  is defined in Table 10.1.3.1-1 intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in UL subframe *n*.

For a UE not configured with *harqTimingTDD = TRUE*, for TDD and if a UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations, or if a UE is configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell, or for FDD-TDD and primary cell frame structure type 2 and if a serving cell *c* is frame structure type 2, then the UE shall upon detection of a PDSCH transmission within subframe(s)  for serving cell , where  intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in UL subframe *n*, wherein set contains values of such that subframe *n-k* corresponds to a DL subframe or a special subframe for serving cell , where DL subframe or special subframe of serving cell  is according to the higher layer parameter *eimta-HARQ-ReferenceConfig-r12* if the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* for serving cell  and according to *harq-ReferenceConfig-r14* if configured*;*  defined in Table 10.1.3.1-1 (where "UL/DL configuration" in Table 10.1.3.1-1 refers to the "DL-reference UL/DL configuration") is associated with subframe *n.*

For a UE configured with *harqTimingTDD = TRUE*, for TDD and if a UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations, or for FDD-TDD and primary cell frame structure type 2 and if a serving cell *c* is frame structure type 2,

- if the UE is configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell , then the UE shall upon detection of a PDSCH transmission within subframe(s)  for serving cell , where  intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in UL subframe *n*, wherein set contains values of such that subframe *n-k* corresponds to a DL subframe or a special subframe for serving cell , where  is defined in Table 10.1.3.1-1 (where "UL/DL configuration" in Table 10.1.3.1-1 refers to the "DL-reference UL/DL configuration") is associated with subframe *n.*

- if the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell , then the UE shall upon detection of a PDSCH transmission within subframe(s)  for serving cell , where  intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in UL subframe *n*, wherein set contains values of such that subframe *n-k* corresponds to a DL subframe or a special subframe for serving cell , where  is defined in Table 10.1.3A-1 (where "UL/DL configuration" in Table 10.1.3A-1 refers to the "DL-reference UL/DL configuration") is associated with subframe *n.*

For a non-BL/CE UE, and for FDD-TDD and primary cell frame structure type 2, if a serving cell  is frame structure type 1 and a UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell , then the UE shall upon detection of a PDSCH transmission within subframe(s)  for serving cell , where , and is defined in Table 10.1.3A-1 intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in subframe *n*.

For FDD-TDD and primary cell frame structure type 2, if a serving cell  is frame structure type 1 and a UE is configured to monitor PDCCH/EPDCCH in another serving cell for scheduling serving cell , then the UE shall upon detection of a PDSCH transmission within subframe(s)  for serving cell , where , and is defined in Table 10.1.3.1-1, intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in subframe *n*, where "UL/DL configuration" in Table 10.1.3.1-1 refers to the "DL-reference UL/DL configuration" of serving cell .

For TDD, if HARQ-ACK repetition is enabled, upon detection of a PDSCH transmission within subframe(s) , where  and  is defined in Table 10.1.3.1-1 intended for the UE and for which HARQ-ACK response shall be provided, and if the UE is not repeating the transmission of any HARQ-ACK in subframe  corresponding to a PDSCH transmission in a downlink or special subframe earlier than subframe , the UE:

- shall transmit only the HARQ-ACK response (corresponding to the detected PDSCH transmission in subframe) on PUCCH in UL subframe and the next UL subframes denoted as , …,;

- shall not transmit any other signal/channel in UL subframe , , …,; and

- shall not transmit any HARQ-ACK response repetitions corresponding to any detected PDSCH transmission in subframes , where , is the set defined in Table 10.1.3.1-1 corresponding to UL subframe , and .

For TDD, HARQ-ACK bundling, if the UE detects that at least one downlink assignment has been missed as described in Clause 7.3, the UE shall not transmit HARQ-ACK on PUCCH if HARQ-ACK is the only UCI present in a given subframe.

For FDD, a BL/CE UE shall upon detection of a PDSCH intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.2.1 in subframe(s) *n+ki* with *i =0,1, …, N-1*, where

- subframe *n-k* is the last subframe in which the PDSCH is transmitted, where

- if the UE is in half-duplex FDD operation and is not configured with higher layer parameter *ce-PDSCH-14HARQ-Config* and is configured with CEModeA and higher layer parameter *ce-HARQ-AckBundling* and the 'HARQ-ACK bundling flag' in the corresponding DCI is set to 1, or if the UE is configured with higher layer parameter *ce-SchedulingEnhancement*

- is given by the 'HARQ-ACK delay' field in the corresponding DCI, and the HARQ-ACK delay value is determined based on the higher layer parameters according to Table 7.3.1-2;

- if the UE is in half-duplex FDD operation and is configured with higher layer parameter *ce-PDSCH-14HARQ-Config* and is configured with CEModeA, and 'PDSCH scheduling delay and HARQ-ACK delay for 14 HARQ' field is present in the corresponding DCI,

- is given by the HARQ-ACK delay value, as defined in [4], in the corresponding DCI,

- otherwise

-

*- 0≤k0<k1<…,kN-1* and the value of and  is provided by higher layer parameter *pucch-NumRepetitionCE-format1,* if configured, otherwise it is provided by higher layer parameter *pucch-NumRepetitionCE*-*Msg4-Level0-r13, pucch-NumRepetitionCE-Msg4-Level1-r13, pucch-NumRepetitionCE-Msg4-Level2-r13* or *pucch-NumRepetitionCE-Msg4-Level3-r13* depending on whether the most recent PRACH coverage enhancement level for the UE is 0, 1, 2 or 3, respectively; and

 if *N>1*

- subframe(s) *n+ki* with *i=0,1,…,N-1* are *N* consecutive BL/CE UL subframe(s) immediately after subframe *n-1*, and the set of BL/CE UL subframes are configured by higher layers;

 otherwise

- k0 =0

except if the UE is configured with higher layer parameter *ce-PDSCH-MultiTB-Config* and multiple TB are scheduled in the corresponding DCI.

For FDD, if a BL/CE UE is configured with CEModeA, and if the UE is not configured with higher layer parameter *harq-AckBundling* in *ce-PDSCH-MultiTB-Config* and multiple TB are scheduled in the corresponding DCI, the BL/CE UE shall upon detection of a PDSCH intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.2.1 in subframe(s) with , *i =0,1, …, N-1*, where

- is the number of scheduled TB determined in the corresponding DCI;

- if the UE is not configured with higher layer parameter *interleaving* in *ce-PDSCH-MultiTB-Config* and the UE is not in half-duplex FDD operation

- ,

- otherwise

- **,**

- is the last subframe in which the PDSCH containing TB is transmitted;

- subframe is the last subframe in which the PDSCH is transmitted;

- denotes the number of consecutive subframes including non-BL/CE subframes where the PUCCH with HARQ ACK for TB with repetition number of *N* is transmitted;

and

*- 0≤k0<k1<…,kN-1* and the value of and  is provided by higher layer parameter *pucch-NumRepetitionCE-format1,* if configured, otherwise it is provided by higher layer parameter *pucch-NumRepetitionCE*-*Msg4-Level0-r13, pucch-NumRepetitionCE-Msg4-Level1-r13, pucch-NumRepetitionCE-Msg4-Level2-r13* or *pucch-NumRepetitionCE-Msg4-Level3-r13* depending on whether the most recent PRACH coverage enhancement level for the UE is 0, 1, 2 or 3, respectively; and

 if *N>1*

- subframe(s) with *i=0,1,…,N-1* for TB are *N* consecutive BL/CE UL subframe(s) immediately after subframe , and the set of BL/CE UL subframes are configured by higher layers;

 otherwise

- k0 =0

For FDD, if a BL/CE UE is configured with CEModeA, and if the UE is configured with higher layer parameter *harq-AckBundling* in *ce-PDSCH-MultiTB-Config* and multiple TB are scheduled in the corresponding DCI, the BL/CE UE shall upon detection of a PDSCH intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.2.1 in subframe(s) with , *i =0,1, …, N-1*, where

- is the number of scheduled TB determined in the corresponding DCI;

-  is the multi-TB HARQ-ACK bundling size;

- if the UE is not configured with higher layer parameter *interleaving* in *ce-PDSCH-MultiTB-Config* and the UE is not in half-duplex FDD operation

- ,

- otherwise

- subframe **,**

- subframe is the last subframe in which the PDSCH containing TB bundle is transmitted;

- subframe is the last subframe in which the PDSCH is transmitted;

- denotes the number of consecutive subframes including non-BL/CE subframes where the PUCCH with HARQ ACK for TB bundle with repetition number of *N* is transmitted;

and

*- 0≤k0<k1<…,kN-1* and the value of and  is provided by higher layer parameter *pucch-NumRepetitionCE-format1,* if configured, otherwise it is provided by higher layer parameter *pucch-NumRepetitionCE*-*Msg4-Level0-r13, pucch-NumRepetitionCE-Msg4-Level1-r13, pucch-NumRepetitionCE-Msg4-Level2-r13* or *pucch-NumRepetitionCE-Msg4-Level3-r13* depending on whether the most recent PRACH coverage enhancement level for the UE is 0, 1, 2 or 3, respectively; and

 if *N>1*

- subframe(s) with *i=0,1,…,N-1* for TB bundle are *N* consecutive BL/CE UL subframe(s) immediately after subframe, and the set of BL/CE UL subframes are configured by higher layers;

 otherwise

- k0 =0

For TDD, a BL/CE UE shall upon detection of a PDSCH within subframe(s) , where  and  is defined in Table 10.1.3.1-1 intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.3.1 in subframe(s) *n+ki* with *i =0,1, …, N-1*, where

- subframe *n-k* is the last subframe in which the PDSCH is transmitted; and

*- 0≤k0<k1<…,kN-1* and the value of and  is provided by higher layers parameter *pucch-NumRepetitionCE-format1,* if configured, otherwise it is provided by higher layer parameter *pucch-NumRepetitionCE*-*Msg4-Level0-r13, pucch-NumRepetitionCE-Msg4-Level1-r13, pucch-NumRepetitionCE-Msg4-Level2-r13* or *pucch-NumRepetitionCE-Msg4-Level3-r13* depending on whether the most recent PRACH coverage enhancement level for the UE is 0, 1, 2 or 3, respectively; and

if *N>1*

- subframe(s) *n+ki* with *i=0,1,…,N-1* are *N* consecutive BL/CE UL subframe(s) immediately after subframe *n-1*, and the set of BL/CE UL subframes are configured by higher layers;

 otherwise

- k0 =0

except if the UE is configured with higher layer parameter *ce-PDSCH-MultiTB-Config* and multiple TB are scheduled in the corresponding DCI.

For TDD, if a BL/CE UE is configured with higher layer parameter *ce-PDSCH-MultiTB-Config* and multiple TBs are scheduled in the corresponding DCI, the BL/CE UE shall upon detection of a PDSCH intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response using the same  derived according to Clause 10.1.3.1 in subframe(s) *+ki* with , *i =0,1, …, N-1*, where

- is the number of TB bundles

- if the UE is not configured with higher layer parameter *harq-AckBundling* in *ce-PDSCH-MultiTB-Config,* with bundle consisting of only *.*

- Else, the value of and the corresponding TBs in each bundle is determined according to clause 7.3

- is the number of scheduled TB determined in the corresponding DCI;

- ,

- is the last subframe in which the PDSCH containing TB bundle is transmitted;

- denotes the number of consecutive subframes including subframes that are not BL/CE UL subframes where the PUCCH with HARQ ACK for TB bundle with repetition number of *N* is transmitted;

and

*- 0≤k0<k1<…,kN-1* and the value of and  is provided by higher layers parameter *pucch-NumRepetitionCE-format1,* if configured, otherwise it is provided by higher layer parameter *pucch-NumRepetitionCE*-*Msg4-Level0-r13, pucch-NumRepetitionCE-Msg4-Level1-r13, pucch-NumRepetitionCE-Msg4-Level2-r13* or *pucch-NumRepetitionCE-Msg4-Level3-r13* depending on whether the most recent PRACH coverage enhancement level for the UE is 0, 1, 2 or 3, respectively; and

- subframe(s) with *i=0,1,…,N-1* for TB bundle are *N* consecutive BL/CE UL subframe(s) immediately after subframe , and the set of BL/CE UL subframes are configured by higher layers.

The uplink timing for the ACK corresponding to a detected PDCCH/EPDCCH indicating downlink SPS release shall be the same as the uplink timing for the HARQ-ACK corresponding to a detected PDSCH, as defined above.

For a BL/CE UE, the uplink timing for the ACK corresponding to a detected MPDCCH indicating downlink SPS release shall be the same as the uplink timing for the HARQ-ACK corresponding to a detected PDSCH, as defined above.

For a BL/CE UE, if a first HARQ-ACK transmission associated to a first set of PDSCH partially collides with a second HARQ-ACK transmission associated to a second set of PDSCH transmissions, the last PDSCH of the first set of PDSCH transmissions being detected before the last PDSCH of the second set of PDSCH transmissions, the UE shall drop the second HARQ-ACK transmission.

Table 10.2-1: DL-reference UL/DL configuration for serving cell based on pair formed by (primary cell UL/DL configuration, secondary cell UL/DL configuration)

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

<Unchanged parts are omitted>