**3GPP TSG-RAN WG4 Meeting # 111R4-2409719**

**Fukuoka, Japan, 20 May 2024 – 24 May 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** |  | **rev** | **1** | **Current version:** |  |  |
|  | | | | | | | | |
| *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 |  | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Draft CR to TS 38.133 on UL Transmit timing for MIMO Evolution. | | | | | | | | | |
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| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
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| ***Work item code:*** |  | | | | |  | ***Date:*** | | | 13 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be 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-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)*  *Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Maintenance of timing requirements for mTRP mDCI case. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Some editorial correction to improve the readability of the specfication. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | MIMO Evolution Feature not completely defined. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.1.1, 7.1.2, 7.1.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.533 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | This CR was planned as part of CR slpit in RAN4#108bis, R4-2317371, WF on R18 NR MIMO RRM requirement, Samsung. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | **R4-2409719** | | | | | | | | |

==== Start of changes ====

# 7 Timing

## 7.1 UE transmit timing

### 7.1.1 Introduction

The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. For serving cell(s) in pTAG, UE shall use the SpCell as the reference cell for deriving the UE transmit timing for cells in the pTAG. For serving cell(s) in sTAG, UE shall use any of the activated SCells as the reference cell for deriving the UE transmit timing for the cells in the sTAG. UE initial transmit timing accuracy and gradual timing adjustment requirements are defined in the following requirements.

In the requirements of clause 7.1.2, the term reference cell on a carrier frequency subject to CCA is not available at the UE refers to when at least one SSB is configured by gNB, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available during at least one discovery burst transmission window, at the UE due to DL CCA failures at gNB during the last 1280 ms; otherwise the reference cell on the carrier frequency subject to CCA is considered as available at the UE.

[For UE supporting [RACH-based early TA acquisition] for LTM, and if the candidate cell is a neighbor cell,

- UE shall have capability to follow the frame timing of the reference cell. The PRACH transmission take place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. For the neighbor cell to which PRACH is transmitted, UE shall use this neighbor cell as the reference cell for deriving transmit timing. UE initial transmit timing accuracy is defined in the following requirements.]

Editor’s Note: The above requirements for RACH-based early TA acquisition can be revisited if any further agreements in other WG have impacts on the DL reference timing

Editor’s Note: FFS whether additional handling is needed when the candidate cell is a secondary serving cell.

For multi-DCI based multi-TRP operation with two TAs, for each TAG, the uplink transmission timing takes place before the reception of the downlink reference point. Where the reference point for PUCCH/PUSCH/SRS for each TAG is first detected path (in time) of one of the corresponding downlink reference signal(s) of the reference cell associated with the one of the activated *DLorJointTCIState*  [TS 38.331] having the same TAG. Where is commanded by the network independently for each TAG [TS 38.331].

Reference point for intra-cell PRACH transmission triggered by PDCCH order (for message 1 or Msg.A), is the first detected path (in time) of one of the downlink reference signal(s) in the active DL or joint TCI state of the reference cell associated with the same coresetPoolIndex as PDCCH carrying PDCCH order if PRACH association indicator is 0, and that of the other coresetPoolIndex if PRACH association indicator is 1.

In the requirements of clause 7.1.2, the SSB applies for both CD-SSB and NCD-SSB if the UE supports *ncd-SSB-BWP-Wor-r18*.

The UE shall have capability to follow the frame timing change of the reference cell in connected state or when transmitting PUSCH on CG resources for SDT in RRC\_Inactive.

### 7.1.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission, or it is the first transmission sent on the PSCell for activating the deactivated SCG without RACH.

- when it is the transmission for PUSCH on CG resources for SDT in RRC\_Inactive.

- when it is the first transmission on target cell after UE receives LTM cell switch command.

*Editor’s Note: FFS the timing accuracy requirements for UE-based TA derivation.*

When the UL SCS is 120 kHz or smaller, the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. When the UL SCS is 480 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 80 ms. When the UL SCS is 960 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 40 ms.

Editor’s Note: For LTM, the impact to uplink timing accuracy requirements due to the SSB availability for PDCCH ordered RACH before cell switch is FFS.

The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at the UE antenna. *N*TA for PRACH is defined as 0.

 (in *Tc* units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3 was applied. *N*TA for other channels is not changed until next timing advance is received. The value ofdepends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). is defined in Table 7.1.2-2.

For multi-DCI based multi-TRP operation with two Tas for first transmission in a DRX cycle for PUCCH, PUSCH and SRS, UE initial transmission timing error requirements specified in this clause is applicable for each TAG and shall be met for each TAG separately. The reference point for each TAG for the PUCCH/PUSCH/SRS is defined clause 7.1.1. For intra-cell PRACH transmission triggered by PDCCH order (for message 1 or Msg.A), the reference point is defined as the downlink reference point in Clause 7.1.1.

Table 7.1.2-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 1 | 15 | 15 | 12\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 10\*64\*Tc |
|  | 30 | 15 | 8\*64\*Tc |
|  |  | 30 | 8\*64\*Tc |
|  |  | 60 | 7\*64\*Tc |
| 2-1 | 120 | 60 | 3.5\*64\*Tc |
|  |  | 120 | 3.5\*64\*Tc |
|  | 240 | 60 | 3\*64\*Tc |
|  |  | 120 | 3\*64\*Tc |
| 2-2 | 120 | 120 | 3.5\*64\*Tc |
|  |  | 480 | 1.58\*64\*Tc |
|  | 480 | 120 | 2.86\*64\*Tc |
|  |  | 480 | 1.35\*64\*Tc |
|  |  | 960 | 0.90\*64\*Tc |
|  | 960 | 120 | 2.80\*64\*Tc |
|  |  | 480 | 1.13\*64\*Tc |
|  |  | 960 | 0.86\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

Table 7.1.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 FDD or TDD band with neither E-UTRA–NR nor NB-IoT–NR coexistence case | 25600 (Note 1) |
| FR1 FDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 0 (Note 1) |
| FR1 TDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 39936 (Note 1) |
| FR2 | 13792 |
| Note 1: The UE identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [2]. If UE is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band. In case of multiple UL carriers in the same TAG, UE expects that the same value of n-TimingAdvanceOffset is provided for all the UL carriers according to clause 4.2 in TS 38.213 [3] and the value 39936 of  can also be provided for a FDD serving cell.  Note 2: Void | |

When it is not the first transmission in a DRX cycle or there is no DRX cycle, and when it is the transmission for PUCCH, PUSCH and SRS transmission, the UE shall be capable of changing the transmission timing according to the received downlink frame of the reference cell except when the timing advance in clause 7.3 is applied.

Table 7.1.2-3: void

If the UE uses a reference cell on a carrier frequency subject to CCA for deriving the UE transmit timing, then the UE shall meet all the transmit timing requirements defined in clause 7.1.2 provided that the reference cell is available at the UE. If the reference cell is not available at the UE on a carrier frequency subject to CCA, then the UE is allowed to transmit in the uplink provided that the UE meets all the transmit timing requirements defined in clause 7.1.2; otherwise the UE shall not transmit any uplink signal.

If a reference cell on a carrier frequency belonging to the PTAG, which is subject to CCA, is not available at the UE then the UE is allowed to use any of available activated SCell(s) at the UE in PTAG as a new reference cell. If the SCell used as reference cell is deactivated, or becomes not available, the UE is allowed to use another active serving cell in PTAG as new reference cell.

If a reference cell on a carrier frequency belonging to the STAG, which is subject to CCA is not available at the UE then the UE is allowed to use any of available activated SCell(s) at the UE in STAG as a new reference cell.

#### 7.1.2.1 Gradual timing adjustment

Requirements in this section shall apply regardless of whether the reference cell is on a carrier frequency subject to CCA or not.

When the transmission timing error between the UE and the reference timing exceeds ±Te then the UE shall adjust the timing such that timing error is to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.

2) The minimum aggregate adjustment rate shall be Tp per second.

3) The maximum aggregate adjustment rate shall be Tq per 200 ms for SCS of UL signals smaller or equal to 120 kHz and 100 ms for SCS of upling signals larger or equal to 480 kHz.

where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 7.1.2.1-1.

For multi-DCI based multi-TRP operation with two TAs, gradual timing adjustment specified in this clause applies for each TAG and shall be met for each TAG. The reference point for the PUCCH/PUSCH/SRS is defined in clause 7.1.1., For intra-cell PRACH transmission triggered by PDCCH order (for message 1 or Msg.A), the reference point is defined as the downlink reference point in Clause 7.1.1.

Table 7.1.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2-1 | 60 | K\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | K\*64\*Tc | 2.5\*64\*Tc |
| 2-2 | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 480 | 0.8\*64\*Tc | 0.8\*64\*Tc |
|  | 960 | 0.8\*64\*Tc | 0.8\*64\*Tc |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6]  NOTE 2: When *highSpeedMeasFlagFR2-r17* is configured for UE supporting power class 6, K = 4.5; otherwise, K = 2.5. | | | |

===== End of changes =====