**3GPP TSG-RAN4 Meeting #95-eR4-2008531**

**Electronic** **Meeting, 25th May- 5th June 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  |  | **CR** | **0628** | **rev** | **1** | **Current version:** | **15.9.0** |  |
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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 |  | Core Network |  |

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| ***Title:***  | CR on Active TCI State Switching requirements - Rel15 |
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| ***Source to WG:*** | Apple |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** |  |
|  |  |  |  |  |
| ***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-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:*** | 1. There is mismatch between RAN1 and RAN4 spec for MAC CE based TCI state switch. Particularly, until when the UE can receive with the old TCI state. According to RAN1 spec the UE shall receive with the new TCI state starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH. In RAN4 we define additional delay to account for Rx beam sweeping time and time for tracking to account for realistic scenarios for the when the UE can receive with the new TCI state. According to RAN1 spec, the UE should be able to receive with old TCI state until slot . In RAN4 we have an extension of the time until which UE can receive with old TCI state. This creates a mismatch between RAN1 and RAN4. We should update RAN4 spec to be consistent with RAN1 on up to when UE can receive with old TCI state.
2. Currently during RRC based TCI state switch UE is not required to transmit or receive during entire switching delay. The UE needs to transmit ACK/NACK at a minimum for the received PDSCH. The restriction should start after THARQ rather than the slot when PDSCH is received.
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| ***Summary of change:*** | 1. Changes from R4-2005430. [Endorsed in RAN4#94e-Bis]
2. For MAC CE based TCI state switch for both known and unknown case : The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + . The UE is not required to receive with old or target TCI state from slot n+ THARQ + until the end of the switching delay.
3. For RRC based switch, PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH from slot n + THARQ + 1 until the end of switching period.
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| ***Consequences if not approved:*** | Discrepancy between RAN1 and RAN4 spec regarding UE behavior for MAC based TCI state switch. Unclear when UE can transmit HARQ feedback for PDSCH carrying RRC commad for BWP switch.  |
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| ***Clauses affected:*** | Section 8.10 |
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|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

Start of Change 1

## 8.10 Active TCI state switching delay

8.10.1 Introduction

The requirements in this clause apply for a UE configured with one or more TCI state configurations on serving cell in MR-DC or standalone NR. UE shall complete the switch of active TCI state within the delay defined in this clause.

8.10.2 Known conditions for TCI state

The TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of active TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state

- TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target TCI state before the TCI state switch command

- The TCI state remain detectable during the TCI state switching period

- The SSB associated with the TCI state remain detectable during the TCI switching period

- SNR of the TCI state ≥ -3dB

Otherwise, the TCI state is unknown.

8.10.3 MAC-CE based TCI state switch delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + . The UE is not required to receive with old or target TCI state from slot n+ THARQ + until the end of the switching delay.

Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE;

 TSSB-proc = 2 ms;

TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + . The UE is not required to receive with old or target TCI state from slot n+ THARQ + until the end of the switching delay.

Where T L1-RSRP is the time for L1-RSRP measurement for Rx beam refinement, defined as

- TL1-RSRP\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

 - configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

TOuk = 1 for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

TOuk = 1 when TCI state switching involves other QCL types

TL1-RSRP\_Measurement\_Period\_SSB = 0 for SSBin FR2 and TL1-RSRP\_Measurement\_Period\_CSI-RS = 0 for CSI-RSin FR2, provided that the TCI state switching involves QCL-TypeA, QCL-TypeB or QCL-TypeC only.

Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

During MAC-CE based TCI state switch the UE is allowed an interruption due to one shot timing adjustment on the serving or any activated serving cells as defined in clause 8.2.

8.10.4 DCI based TCI state switch delay

If the target TCI state is known, when a UE is configured with the higher layer parameter *tci-PresentInDCI* which is set as 'enabled'for the CORESET scheduling PDSCH at slot n, UE shall be able to receive PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+*timeDurationForQCL*, where, *timeDurationForQCL* is the time required by the UE to perform PDCCH reception and applying spatial QCL information received in DCI for PDSCH processing as described in TS 38.214 [26], the value of *timeDurationForQCL* is defined in TS 38.331 [2].

The known condition for TCI state defined in clause 8.10.2 is applied.

During DCI based TCI state switch the UE is allowed an interruption due to one shot timing adjustment on the serving or any activated serving cells as defined in clause 8.2.

8.10.5 RRC based TCI state switch delay

If the target TCI state is known, upon receiving PDSCH carrying RRC activation command at slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ TRRC\_processing +TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. Where TRRC\_processing is the RRC processing delay, Tfirst-SSB, TSSB-proc and TOk are defined in clause 8.10.3. The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH from slot n + THARQ + 1 until the end of switching period.

Tfirst-SSB is time to first SSB transmission after RRC processing by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

If the target TCI state is unknown, upon receiving PDSCH carrying RRC activation command at slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ TRRC\_processing  +TL1-RSRP +TOuk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. Where TRRC\_processing is the RRC processing delay, and TOuk , TL1-RSRP are defined in clause 8.10.3. The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH from slot n + THARQ + 1 until the end of switching period.

Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

Tfirst-SSB is time to first SSB transmission after RRC processing time at the UE for other QCL types;

The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

The requirements for RRC based TCI state switch delay apply when only 1 TCI state is configured in RRC TCI state list.

During RRC based TCI state switch the UE is allowed an interruption due to one shot timing adjustment on the serving or any activated serving cells as defined in clause 8.2.

### 8.10.6 Active TCI state list update delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI state at the first slot that is after n+ THARQ + +TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. Where THARQ, Tfirst-SSB, TSSB-proc and TOk are defined in clause 8.10.3.

End of Change 1