**3GPP TSG- Meeting #**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
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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 for eUTCI state switching requirements |
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| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | sDCI DL Switching- 1. Applicability of requirements is not clear
2. Terms were defined in different places, repeated statements under each case

mDCI DL Switching1. Applicability under cell with diff PCI is missing
2. Different requirements were in different indents
3. Terms were defined in different places, repeated statements under each case

mDCI UL switching1. Conditions of applicability captured in introduction are repeated
2. Extra delay for time tracking of DL Ref RS is missing
3. The DCI requirements are incorrect.
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| ***Summary of change:*** | sDCI DL Switching- 1. Added applicability of requirements
2. Re-arranged definiton of some terms, deleted repeated statements under all cases and added one after all cases

mDCI DL Switching- 1. Added applicability of requirements
2. Re-arranged definiton of some terms, deleted repeated statements under all cases and added one after all cases
3. Aligned the requirements with same main indentation

mDCI UL switching1. Deleted conditions of applicability captured in introduction for 2TA, RTD>CP
2. Corrected DCI requirements.
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| ***Consequences if not approved:*** | Requirements for eUTCI will be incorrect |
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| ***Clauses affected:*** |  |
|  |  |
|  | **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:*** |  |

Change 1

8.21.3 MAC-CE based downlink TCI state switch delay

The requirements in this clause shall apply for DL TCI state switch using separate DL TCI state or joint TCI state of unified TCI state switch framework and having two indicated TCI states.

In case of joint TCI state based dual TCI state switch, if the target PL-RS is not maintained, UE is not expected to receive on DL based on the target TCI state before UE completes the DL and UL TCI state switch of both TRPs. In case of single TCI state switch requirements specified in clause 8.15.3 apply.

If both the target TCI states are known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + max{TOk1\*(Tfirst-SSB1 + AD1\*TSSB1 + TSSB-proc), TOk2\*(Tfirst-SSB2 + AD2\*TSSB2 + TSSB-proc)} / NR slot length.

Among the dual target TCI states indicated for switch, if the one of the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot THARQ + + TL1-RSRP1 + max {TOuk1\*(Tfirst-SSB1+ AD1\*TSSB1 + TSSB-proc), TOk2\*(Tfirst-SSB2 + TSSB-proc)} / *NR slot length*.

If the both of the dual target TCI state are unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + max{TL1-RSRP1 +TOuk1\*(Tfirst-SSB1+ TSSB-proc), TL1-RSRP2 +TOk2\*(Tfirst-SSB2+ TSSB-proc)} / *NR slot length*.

The UE shall be able to receive UE-dedicated PDCCH/PDSCH with the old TCI state until slot n+ THARQ + .

Where,

- THARQ (in slot) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- T L1-RSRP1 = 0 for the first TCI state and T L1-RSRP2 = 0 for the second TCI state in FR1 or when the TCI state switching not involving QCL-TypeD in FR2. Otherwise,

- T L1-RSRP1 for the first TCI state and T L1-RSRP2 for the second TCI state are the time for Rx beam refinement in FR2, 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

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- 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

- TOuk1 for the first TCI state and TOuk2 for the second TCI state TOuk1 = 1 and TOuk2 = 1 for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk1 = 1 and TOuk2 = 1when TCI state switching involves other QCL types only

- Tfirst-SSB1 is time to first SSB transmission of first TCI states of the pair of TCI states after L1-RSRP measurement when TCI state switching involves QCL-TypeD; Tfirst-SSB2 is time to second SSB transmission of first TCI states of the pair of TCI states after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB1 is time to first SSB transmission of first TCI states of the pair of TCI states after MAC CE command is decoded by the UE for other QCL types; Tfirst-SSB2 is time to second SSB transmission of first TCI states of the pair of TCI states 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

For FR2 both of the dual target TCI state are unknown when SSB are adjacent, longer delay is expected.

Change 2

8.22.3 MAC-CE based downlink TCI state switch delay

If the MAC-CE from two TRPs indicating TCI state switch are not overlapped, requirements specified in clause 8.15.3 are applicable for each target TCI state switch.

The requirements in this clause shall apply for DL TCI state switch using separate DL TCI state or joint TCI state of unified TCI state switch framework.

In case that source RS in DL TCI state or joint TCI state is associated with a PCI different from that of the serving cell, the requirements in this clause shall apply if the cell with different PCI satisfies the known cell condition defined in 8.15.1. If the known cell condition is not met, longer delay may be expected.

In case of joint TCI state switch, if the target PL-RS is not maintained, UE is not expected to receive on DL based on the target TCI state before UE completes the DL and UL TCI state switch.

Upon receiving PDSCH carrying MAC-CE activation command in slot n if the target TCI state is known, the UE shall be able to receive UE-dedicated PDCCH/PDSCH 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+ OL\*TSSB) / *NR slot length*.

Upon receiving PDSCH carrying MAC-CE activation command in slot n if the target TCI state is unknown, the UE shall be able to receive UE-dedicated PDCCH/PDSCH 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+ OL\*TSSB)) / *NR slot length*.

The UE shall be able to receive UE-dedicated PDCCH/PDSCH with the old TCI state until slot n+ THARQ + .

Where,

- THARQ (in slot) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is the time to the first SSB transmission after MAC CE command is decoded by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TSSB-proc = 2 ms;

- TOk  = 0 if the target TCI state have QCL relationship with a RS of a TCI state in the active list of TCI states or if the target TCI state is in the active list of TCI states, otherwise TOk = 1;

* OL = 1 if the SSB overlaps or is adjacent to the SSB from the other TRP in FR2 and the SSB is associated to the TRP with the lowest corestPoolIndex, 0, otherwise.

- T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSRP\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1, when receive timing difference is within CP,

- 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, when receive timing difference is within CP

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- 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 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

Change 3

8.24.3 MAC-CE based uplink TCI state switch delay

The requirements in this clause shall apply for UL TCI state switch using separate UL TCI state or joint TCI state of unified TCI state switch framework.

In case that source RS in UL TCI state or joint TCI state is associated with a PCI different from that of the serving cell, the requirements in this clause shall apply if the cell with different PCI satisfies the known cell condition defined in 8.24.1. If the known cell condition is not met, longer delay may be expected.

In case of joint TCI state switch, UE is not expected to transmit on UL based on the target TCI state before UE completes the DL and UL TCI state switch.

For separate UL TCI state switch or joint TCI state switch for PUCCH or PUSCH, or semi-persistent/aperiodic/periodic SRS, when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1, upon receiving PDSCH carrying MAC-CE activation command in slot n on serving cell,

- If target TCI state is known, the UE shall be able to transmit uplink signal with the target TCI state in the slot n+THARQ + + NM*\** (Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms) / *NR slot length*.

- If target TCI state is unknown, the UE shall be able to transmit uplink signal with the target TCI state in the slot n+THARQ + *+* (TL1-RSRP+ Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms) / *NR slot length*.

The UE shall be able to transmit with the old UL TCI state until slot n+ THARQ + .

- *FFS on additional time tracking of DL Ref RS for 2TA* TOuk-ref (Tfirst-SSB-DLRef + 2ms)

Where,

- THARQ (in slot) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

- NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise.

In FR2, in case that the target PL-RS associated with or included in the target UL or joint TCI state is SSB, the requirements in this clause shall apply when this target PL-RS is maintained by the UE.

- PL-RS is maintained provided:

- the target PL-RS is associated with or included in the UL or joint TCI states in the active TCI list for PUSCH/PUCCH/SRS transmissions

- There are no more than 4 different RS activated as PL-RS per serving cell among all active UL TCI states (UL or joint TCI state) for PUSCH/PUCCH/SRS transmissions

- The target pathloss reference signal remains detectable during TCI state switching period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the TCI state switching period.

- SNR of the associated SSB ≥-3dB

- Tfirst\_target-PL-RS is time to first pathloss RS transmission after L1-RSRP measurement when target TCI state is unknown.

- Tfirst\_target-PL-RS is time to first pathloss RS transmission after MAC CE command is decoded by the UE for known TCI State.

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal which would be SSB or NZP CSI-RS when PL-RS is associated with serving cell

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal which would be SSB when PL-RS is associated with PCI different from serving cell

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1 or 9.13.4.1,

- 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

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- 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

- TOk-ref = 1, if the target TCI state is known, and there is no active DL TCI state for DL timing reference with the same coresetPoolIndex for separate UL TCI state , 0 otherwise.

- Tfirst-SSB-DLRef is the time to first SSB for DL timing reference after MAC CE command is decoded when target TCI state is known.

- Tfirst-SSB-DLRef is the time to first SSB for DL timing reference after L1-RSRP measurement when target TCI state is unknown.

- TOuk-ref = 1, for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement

The requirements specified in this clause are applicable if no more than 4 different RSs are activated as PL-RS per serving cell among all active UL (or joint) TCI states

Note: In FR2, the requirements when the target PL-RS is not maintained in this clause apply only when PL-RS are not overlapped or adjacent to the PL-RS of the other TRP.

8.24.4 DCI based uplink TCI state switch delay

For DCI based UL TCI state switch in multi-DCI transmission mode the requirements in section 8.16.6 apply to TCI state associated with each coresetPoolIndex.