**3GPP TSG- Meeting #**

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

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| --- |
|  |
| ***Title:***  |  to define new test case for sDCI mTRP FR2 separate UL TCI state switching |
|  |  |
| ***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)* |
|  |  |
| ***Reason for change:*** | New test case needed for sDCI mTRP FR2 separate UL TCI state switching |
|  |  |
| ***Summary of change:*** | New test case needed for sDCI mTRP FR2 separate UL TCI state switching* Change1: Define a new AoA setup with three active probes (Paragraph added considering previous clause A.3.15.3 as basis, major changes highlighted in green)
* Change 2: Define a new UL TCI State configuration
* Change 3: Define a new configuration for CSI-RS tracking in FR2 (Table added considering previous tables A.3.17.2.1-1 and A.3.17.2.1-2 as basis, major changes highlighted in green)
* Change 4: Define the new test case (Paragraph added considering previous clause A.7.5.13.2 as basis, major changes highlighted in green)
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|  |  |
| ***Consequences if not approved:*** | Incorrect specification |
|  |  |
| ***Clauses affected:*** | A.3.15.x (new), A.3.16A.3, A.3.17.2.1, A.7.5.13.y (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** | Test case defined assuming “Single to dual TCI state switching” |
|  |  |
| ***This CR's revision history:*** |  |

**<< Start of Change #1 >>**

## A.3.15 Angle of Arrival (AoA) for FR2 RRM test cases

>>> Unchanged sections omitted <<<<<

### A.3.15.x Setup X: 3 AoAs

|  |  |
| --- | --- |
|  |  |
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|  |  |

There are 3 active probes in the test. The DL signals, and noise if applicable, transmitted from the three active probes, align to directions (AoAs) which are from the set of directions corresponding to the EIS spherical coverage percentile of the DUT as defined in clause 7.3.4 of TS 38.101-2 [19] for each UE power class. The relative angular offset between the directions (AoAs) of the 3 active probes, shall be changed for each test iteration. Any combinations of two relative angular offsets between 2 active probes specified in Table A.3.15.3-1, is considered as a valid applicable relative angular offsets between 3 active probes for the respective power class.

**<< End of Change #1 >>**

**<< Start of Change #2 >>**

## A.3.16A Unified TCI State Configuration

>>> Unchanged sections omitted <<<<<

### A.3.16A.3 UL TCI states

Table A.3.16A.3-1: UL TCI States

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | UL TCI.State.0 | UL TCI.State.1 | UL TCI.State.2 | UL TCI.State.3 | UL TCI.State.4 |
| ul-TCIState-Id | Id0 | Id1 | Id2 | Id3 | Id4 |
| referenceSignal Note1 | SSB0 | SSB1 | Resource #4 in TRS resource set 1 Note2 | Resource #4 in TRS resource set 2 Note2 | Resource #4 in TRS resource set 3 Note2 |
| pathlossReferenceRS | Resource #4 in TRS resource set 1 Note2 | Resource #4 in TRS resource set 1 Note2 | Resource #4 in TRS resource set 1 Note2 | Resource #4 in TRS resource set 2 Note2 | Resource #4 in TRS resource set 3 Note2 |
| additionalPCI | N/A | configured Note3 | N/A | N/A | N/A |
| Note 1: referenceSignal configurations towards which the UL TCI states are configured are defined in a test-specific manner.Note 2: Reference TRS resource sets are defined in A.3.17, and the applicable TRS resource set(s) are specified in each test case. When a single TRS resource set is configured in a test case, it is considered as resource set 1.Note 3: Only one PCI than serving cell PCI is included in the additionalPCIList, and the additionalPCIIndex is configured as 0. |

**<< End of Change #2 >>**

**<< Start of Change #3 >>**

## A.3.17 Configurations of CSI-RS for tracking

>>> Unchanged sections omitted <<<<<

### A.3.17.2 Configuration of CSI-RS for tracking for FR2

#### A.3.17.2.1 TDD

Table A.3.17.2.1-1: CSI-RS for tracking for SCS=120kHz Set 1

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | TRS.2.1 TDD |
| Bandwidth |  | BW of Active BWPNote 1,3 |
| SCS | kHz | 120 |
| First subcarrier index in the PRB used for CSI-RS  |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the slot used for CSI-RS  |  | l0 = 1 for CSI-RS resource 1 and 3l0 = 5 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type |  | ‘No CDM’ for CSI-RS resource 1,2,3,4 |
| Density (ρ) |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | slots | 80 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | slots | 40 for CSI-RS resource 1 and 241 for CSI-RS resource 3 and 4 |
| EPRE ratio to SSS | dB | 0Note 2 |
| TCI state |  | TCI.State.0 |
| Note 1: BW of TRS is configured same as the BW size of UE active BWP in the RRM test casesNote 2: Unless otherwise specified in the test caseNote 3: If active BWP is larger than 52RBs, BW of TRS is configured as 52RBs. Otherwise, same as active BWP size. |

Table A.3.17.2.1-2: CSI-RS for tracking for SCS=120kHz Set 2

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | TRS.2.2 TDD |
| Bandwidth |  | BW of Active BWPNote 1,3 |
| SCS | kHz | 120 |
| First subcarrier index in the PRB used for CSI-RS  |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the slot used for CSI-RS  |  | l0 = 2 for CSI-RS resource 1 and 3l0 = 6 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type |  | ‘No CDM’ for CSI-RS resource 1,2,3,4 |
| Density (ρ) |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | slots | 80 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | slots | 40 for CSI-RS resource 1 and 241 for CSI-RS resource 3 and 4 |
| EPRE ratio to SSS | dB | 0Note 2 |
| TCI state |  | TCI.State.1 |
| Note 1: BW of TRS is configured same as the BW size of UE active BWP in the RRM test casesNote 2: Unless otherwise specified in the test caseNote 3: If active BWP is larger than 52RBs, BW of TRS is configured as 52RBs. Otherwise, same as active BWP size. |

Table A.3.17.2.1-3: Aperiodic CSI-RS for tracking for SCS=120kHz Set 1

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | TRS.2.3 TDD |
| Bandwidth |  | BW of Active BWPNote 1,3 |
| SCS | kHz | 120 |
| First subcarrier index in the PRB used for CSI-RS  |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the slot used for CSI-RS  |  | l0 = 1 for CSI-RS resource 1 and 3l0 = 5 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type |  | ‘No CDM’ for CSI-RS resource 1,2,3,4 |
| Density (ρ) |  | 3 for CSI-RS resource 1,2,3,4 |
| aperiodicTriggeringOffsetL2 | slots | 2 |
| Aperiodic CSI-RS offset | slots | 2 for CSI-RS resource 1 and 23 for CSI-RS resource 3 and 4 |
| EPRE ratio to SSS | dB | 0Note 2 |
| TCI state |  | TCI.State.0 |
| Note 1: BW of TRS is configured same as the BW size of UE active BWP in the RRM test casesNote 2: Unless otherwise specified in the test caseNote 3: If active BWP is larger than 52RBs, BW of TRS is configured as 52RBs. Otherwise, same as active BWP size. |

Table A.3.17.2.1-z: CSI-RS for tracking for SCS=120kHz Set 3

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | TRS.2.4 TDD |
| Bandwidth |  | BW of Active BWPNote 1,3 |
| SCS | kHz | 120 |
| First subcarrier index in the PRB used for CSI-RS  |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the slot used for CSI-RS  |  | l0 = 3 for CSI-RS resource 1 and 3l0 = 7 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type |  | ‘No CDM’ for CSI-RS resource 1,2,3,4 |
| Density (ρ) |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | slots | 80 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | slots | 40 for CSI-RS resource 1 and 241 for CSI-RS resource 3 and 4 |
| EPRE ratio to SSS | dB | 0Note 2 |
| TCI state |  | TCI.State.2 |
| Note 1: BW of TRS is configured same as the BW size of UE active BWP in the RRM test casesNote 2: Unless otherwise specified in the test caseNote 3: If active BWP is larger than 52RBs, BW of TRS is configured as 52RBs. Otherwise, same as active BWP size. |

Table A.3.17.2.1-w: CSI-RS for tracking for SCS=120kHz Set 4

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | TRS.2.5 TDD |
| Bandwidth |  | BW of Active BWPNote 1,3 |
| SCS | kHz | 120 |
| First subcarrier index in the PRB used for CSI-RS  |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the slot used for CSI-RS  |  | l0 = 4 for CSI-RS resource 1 and 3l0 = 8 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type |  | ‘No CDM’ for CSI-RS resource 1,2,3,4 |
| Density (ρ) |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | slots | 80 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | slots | 40 for CSI-RS resource 1 and 241 for CSI-RS resource 3 and 4 |
| EPRE ratio to SSS | dB | 0Note 2 |
| TCI state |  | TCI.State.3 |
| Note 1: BW of TRS is configured same as the BW size of UE active BWP in the RRM test casesNote 2: Unless otherwise specified in the test caseNote 3: If active BWP is larger than 52RBs, BW of TRS is configured as 52RBs. Otherwise, same as active BWP size. |

**<< End of Change #3 >>**

**<< Start of Change #4 >>**

### A.7.5.13 Unified TCI state switching delay

>>> Unchanged sections omitted <<<<<

#### A.7.5.13.y MAC-CE based active uplink TCI state switch for single-DCI mTRP

##### A.7.5.13.y.1 NR FR2 PCell uplink TCI state switch for two known TCI states

###### A.7.5.13.y.1.1 Test Purpose and Environment

The purpose of this test is to verify fulfillment of the uplink TCI switch delay requirement defined in clause 8.23.3 by a UE capable of beam correspondence without the need for UL beam sweeping. The test scenario comprises one PCell (Cell 1) with two TRPs.

Throughout the test, PDCCH indicating new transmissions shall be sent continuously on PCell to ensure that the UE will send ACK/NACKs on PUCCH.

Before the test starts,

- UE is connected to Cell 1 on radio channel 1.

- UE is configured with a unified DL TCI state, TCI State-0, and SSB0 is configured as QCL source for the TCI state. At the start of test UE is connected to DL TCI state 0.

- UE is configured with 4 UL TCI states, UL TCI state 0, UL TCI state 1, UL TCI state 2, and UL TCI state 3. QCL info to UL TCI state 0, 1, 2, and 3 is provided by SSB0, SSB1, SSB2, and SSB3, respectively. Initially only UL TCI 0 is in the active TCI state list.

- PL-RS is configured for each of the UL TCI states. CSI-RS 0, CSI-RS 1, CSI-RS 2, and CSI-RS 3 are associated with UL TCI state 0, 1, 2, and 3 respectively as PL-RS.

- At the start of the test UE is connected to DL TCI state 0, UL TCI state 0, and UL TCI state 1.

Index of CSI-RS#1 is configured for UE as PUSCH-PathlossReferenceRS-Id-r17 which is indicated in TCI-UL-State-r17 of uplink TCI state 1. CSI-RS#1 is QCLed typeD with SSB#1. UE does not maintain CSI-RS#1 as pathloss RS before the uplink TCI state switching.

Index of CSI-RS#2 is configured for UE as PUSCH-PathlossReferenceRS-Id-r17 which is indicated in TCI-UL-State-r17 of uplink TCI state 2. CSI-RS#2 is QCLed typeD with SSB#2. UE does not maintain CSI-RS#2 as pathloss RS before the uplink TCI state switching.

The test consists of two time periods, T1 and T2. During T1, only the SSBs associated with DL TCI state-0, UL TCI state 0, and UL TCI state 1 are transmitted. At the beginning of T2, transmission of the SSB 2 associated with UL TCI state 2 and transmission of the SSB 3 associated with UL TCI state 3 start. The UE conducts periodic L1-RSRP (i.e., *SSB-Index-RSRP)* reporting for SSB0, SSB1, SSB2, and SSB3. In slot *n*, which is within 1280 ms after UE receiving SSB0, SSB1, SSB2, and SSB3, and after reporting valid results for the SSB0, the SSB1, the SSB2 and the SSB3, the UE receives a MAC-CE indicating a TCI state switch to UL TCI state 2 and to UL TCI state 3.

The test equipment verifies that the UE transmits according to UL TCI state 0 and UL TCI state 1 up until slot *n* + THARQ + , and according to UL TCI state 2 and to UL TCI state 3 from slot *n* + THARQ + + max{NM1*\** (Tfirst\_target-PL-RS1 + 4\*Ttarget\_PL-RS1 + 2ms), NM2*\** (Tfirst\_target-PL-RS2 + 4\*Ttarget\_PL-RS2 + 2ms)} / *NR slot length* and onwards. NM1 is equal to 1. NM2 is equal to 1. Where, THARQ (in slot) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

###### A.7.5.13.y.1.2 Test parameters

The supported test configurations are provided in Table A.7.5.13.y.1.2-1.

General test parameters are provided in Table A.7.5.13.y.1.2-2.

Cell-specific parameters are provided in Table A.7.5.13.y.1.2-3.

OTA-related test parameters are provided in Table A.7.5.13.y.1.2-4.

Table A.7.5.13.y.1.2-1: Supported test configurations

|  |  |
| --- | --- |
| **Config** | **Description** |
| 1 | NR 120 kHz SSB SCS, 100 MHz bandwidth, TDD duplex mode |

Table A.7.5.13.y.1.2-2: General test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | **Comment** |
| NR RF Channel Number |  | 1 | One NR radio channel is used for this test |
| Active PCell |  | Cell 1 | PCell on RF channel number 1. |
| CP length |  | Normal |  |
| DRX |  | OFF |  |
| L1-RSRP reporting period | slot | 160 | Periodic L1-RSRP reporting configured |
| L1-RSRP measured RS |  | SSB0, SSB1, SSB2, SSB3 | L1-RSRP measurements of SSB0, SSB1, SSB2 and SSB3. |
| Number of reported RS |  | 3 | L1-RSRP reporting of measurements on SSB0, SSB1, SSB2, and SSB3. |
| T1 | s | 0.2 |  |
| T2 | s | 2 |  |

Table A.7.5.13.y.1.2-3: NR Cell specific test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Cell 1** |
| Frequency Range |  | FR2 |
| Duplex mode |  | TDD |
| TDD configuration |  | TDDConf.3.1 |
| BWchannel |  | 100 MHz: NRB,c = 66 |
| Data RBs allocated |  | 24 |
| Initial DL BWP Configuration |  | DLBWP.0.2 |
| Dedicated DL BWP Configuration |  | DLBWP.1.1 |
| Initial UL BWP Configuration |  | ULBWP.0.2 |
| Dedicated UL BWP Configuration |  | ULBWP.1.1 |
| PDSCH Reference measurement channel |  | SR.3.1 TDD  |
| RMSI CORESET parameters |  | CR.3.1 TDD  |
| Dedicated CORESET parameters |  | CCR.3.1 TDD  |
| OCNG Patterns |  | OP.5 |
| SSB Configuration |  | SSB.1 FR2 |
| SMTC Configuration |  | SMTC.1  |
| DL TCI State |  | DLorJoint TCI.State.0 |
| PL-RS Configuration for CSI-RS#0 |  | Resource #4 in TRS.2.1 TDD for UL TCI.State.2 |
| PL-RS Configuration for CSI-RS#1 |  | Resource #4 in TRS.2.2 TDD for UL TCI.State.3 |
| PL-RS Configuration for CSI-RS#2 |  | Resource #4 in TRS.2.4 TDD for UL TCI.State.4 |
| PL-RS Configuration for CSI-RS#3 |  | Resource #4 in TRS.2.5 TDD for UL TCI.State.5 |
| UL TCI State-0 Configuration |  | UL TCI.State.2 |
| UL TCI State-1 Configuration |  | UL TCI.State.3 |
| UL TCI State-2 Configuration |  | UL TCI.State.4 |
| UL TCI State-3 Configuration |  | UL TCI.State.5 |
| reportConfigType |  | ssb-Index-RSRP |
| reportConfigType  |  | periodic |
| timeRestrictionForChannelMeasurements |  | configured |
| TRS Configuration |  | TRS.2.1 TDD  |
| Correlation Matrix and Antenna Configuration |  | 1x2 Low |
| EPRE ratio of PSS to SSS | dB | 0 |
| EPRE ratio of PBCH DMRS to SSS |
| EPRE ratio of PBCH to PBCH DMRS |
| EPRE ratio of PDCCH DMRS to SSS |
| EPRE ratio of PDCCH to PDCCH DMRS |
| EPRE ratio of PDSCH DMRS to SSS  |
| EPRE ratio of PDSCH to PDSCH  |
| EPRE ratio of OCNG DMRS to SSSNote 1 |
| EPRE ratio of OCNG to OCNG DMRSNote 1 |
| Propagation Condition |  | AWGN |
| Note 1: OCNG shall be used such that the cell is fully allocated and a constant total transmitted power spectral density is achieved for all OFDM symbols. |

Table A.7.5.13.y.1.2-4: OTA related test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Cell 1** |
| **SSB0** | **SSB1** | **SSB2** | **SSB3** |
| **T1** | **T2** | **T1** | **T2** | **T1** | **T2** | **T1** | **T2** |
| Angle of arrival configuration |  | Setup X according to clause A.3.15.x |
| AoA1 | AoA2 | AoA1 | AoA3 |
| Assumption for UE beams Note 6 |  | Rough |
| NocNote 1 | dBm/15 kHz | -92.1 |
| NocNote 1 | dBm/SCS | -83.1 |
| Ês/Noc | dB | 1 | -infinity | 1 | -infinity | 1 | -infinity | 1 |
| SS-RSRP Note 2 | dBm/120 kHz Note3 | -82.1 | -infinity | -82.1 | -infinity | -82.1 | -infinity | -82.1 |
| IoNote2 | dBm/95.04 MHz Note4 | -55.0 | -58.5 | -55.0 | -58.5 | -55.0 | -58.5 | -55.0 |
| Note 1: Interference from other cells and noise sources not specified in the test is assumed to be constant over subcarriers and time and shall be modelled as AWGN of appropriate power for Noc to be fulfilled.Note 2: SS-RSRP and Io levels have been derived from other parameters for information purposes. They are not settable parameters themselves.Note 3: SS-RSRP minimum requirements are specified assuming independent interference and noise at each receiver antenna port.Note 4: Equivalent power received by an antenna with 0 dBi gain at the centre of the quiet zone.Note 5: As observed with 0dBi gain antenna at the center of the quiet zone.Note 6: Information about types of UE beam is given in B.2.1.3 and does not limit UE implementation or test system implementation. |

###### A.7.5.13.y.1.3 Test Requirements

During T2, the UE shall send L1-RSRP report with results for SSB0 and SSB1.

After receiving MAC-CE command in slot *n*, the UE shall:

- Continue transmitting using UL TCI state 0 and UL TCI state 1 up to and including slot *n* + THARQ +

- Start transmitting using UL TCI state 2 and UL TCI state 3, from slot *n* + THARQ + + max{Tfirst\_target-PL-RS1 + 4\*Ttarget\_PL-RS1 + 2ms, Tfirst\_target-PL-RS2 + 4\*Ttarget\_PL-RS2 + 2ms} / *NR slot length* and onwards.

The rate of correct events observed during repeated tests shall be at least 90%.

**<< End of Change #4 >>**