**3GPP TSG-<TSG/WG> Meeting # 102-e *<R4-2205779>***

**Electronic Meeting, Feb 21st – Mar 3rd , 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** |  | **rev** |  | **Current version:** | **15.12.0** |  |
|  |
| *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 Rel-15 TS 38.101-4: Modification on test setup for PDSCH and PDCCH requirments |
|  |  |
| ***Source to WG:*** | Huawei,HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_newRAT-Perf |  | ***Date:*** | 2022-02-08 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-15 |
|  | *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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | 1. Antenna configuration in Table 5.2.3.1.2-3 is not aligned with agreed simulation assumptions, it should be 2T4R rather than 4T4R for cases with rank 2.
2. PDCCH DMRS mapping depends on precoding granularity, however, only precoding granularity for 2TX is specified in common parameter table. Therefore, it is not clear how PDCCH DMRS is mapping for case with 1TX.
3. For NZP CSI-RS configuration and ZP CSI-RS configuration in common parameters table for PDSCH demodulation requirements, the row index missing. According to the agreed simulation assumptions, the row index should be 3 for 2TX and 5 for 4TX for NZP CSI-RS and 3 for ZP CSI-RS.
 |
|  |  |
| ***Summary of change:*** | 1. Change the antenna configuarion from 4x4 to 2x4 in Table 5.2.3.1.2-3.
2. Add the clarification of PDCCH DMRS mapping type in Table 5.3.1 and Table 7.3.1
3. Add the row index according to the agreed simulation assumptions to the common parameters table for PDSCH demodulation requirments.
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|  |  |
| ***Consequences if not approved:*** | 1. The antenna configuration will still be not correct
2. The PDCCH DMRS mapping type will still be not confusing.
3. The NZP CSI-RS and ZP CSI-RS configuration are still confusing
 |
|  |  |
| ***Clauses affected:*** | 5.2, 5.3, 7.2, 7.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.521-4 |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## 5.2 PDSCH demodulation requirements

The parameters specified in Table 5.2-1 are valid for all PDSCH tests unless otherwise stated.

Table 5.2-1: Common test parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| PDSCH transmission scheme |  | Transmission scheme 1 |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | RBs | 0 |
|  | Subcarrier spacing | kHz | 15 or 30 |
| DL BWP configuration #1 | Cyclic prefix |  | Normal |
|  | RB offset | RBs | 0 |
|  | Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Common serving cell parameters | Physical Cell ID |  | 0 |
|  | SSB position in burst |  | First SSB in Slot #0 |
|  | SSB periodicity | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring |  | Each slot |
|  | Symbols with PDCCH | Symbols | 0, 1 |
| Number of PRBs in CORESET |  | Table 5.2-2 for tested channel bandwidth and subcarrier spacing |
| Number of PDCCH candidates and aggregation levels |  | 1/AL8 |
| CCE-to-REG mapping type |  | Non-interleaved |
| DCI format |  | 1\_1 |
| TCI state |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration |  | Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 |
| Cross carrier scheduling |  | Not configured |
| CSI-RS for tracking | 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 PRB used for CSI-RS  |  | l0 = 6 for CSI-RS resource 1 and 3l0 = 10 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 | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,430 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
|  | CSI-RS offset | Slots | 15 kHz SCS:10 for CSI-RS resource 1 and 211 for CSI-RS resource 3 and 430 kHz SCS:20 for CSI-RS resource 1 and 221 for CSI-RS resource 3 and 4 |
|  | Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4)\*4 |
|  | QCL info |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Row index(Note 3) |  | 3 for 2 CSI-RS ports and 5 for 4 CSI-RS ports |
| First subcarrier index in the PRB used for CSI-RS  |  | k0 = 0 |
| First OFDM symbol in the PRB used for CSI-RS  |  | l0 = 12 |
|  | Number of CSI-RS ports (X) |  | Same as number of transmit antenna |
|  | CDM Type |  | 'No CDM' for 1 transmit antenna'FD-CDM2' for 2 and 4 transmit antenna |
|  | Density (ρ) |  | 1 |
|  | CSI-RS periodicity | Slots | 15 kHz SCS: 2030 kHz SCS: 40 |
|  | CSI-RS offset | Slots | 0 |
|  | Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4)\*4 |
|  | QCL info |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Row index(Note 3) |  | 5 |
| First subcarrier index in the PRB used for CSI-RS  |  | k0 = 4 |
| First OFDM symbol in the PRB used for CSI-RS  |  | l0 = 12 |
| Number of CSI-RS ports (X) |  | 4 |
|  | CDM Type |  | 'FD-CDM2' |
|  | Density (ρ) |  | 1 |
|  | CSI-RS periodicity | Slots | 15 kHz SCS: 2030 kHz SCS: 40 |
|  | CSI-RS offset | Slots | 0 |
|  | Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4)\*4 |
| PDSCH DMRS configuration | Antenna ports indexes |  | {1000} for Rank 1 tests{1000, 1001} for Rank 2 tests{1000-1002} for Rank 3 tests{1000-1003} for Rank 4 tests |
|  | Position of the first DMRS for PDSCH mapping type A |  | 2 |
|  | Number of PDSCH DMRS CDM group(s) without data |  | 1 for Rank 1 and Rank 2 tests2 for Rank 3 and Rank 4 tests |
| TCI state #0 | Type 1 QCL information  | SSB index |  | SSB #0 |
|  |  | QCL Type |  | Type C |
|  | Type 2 QCL information | SSB index |  | N/A |
|  |  | QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information  | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
|  |  | QCL Type |  | Type A |
|  | Type 2 QCL information | CSI-RS resource |  | N/A |
|  |  | QCL Type |  | N/A |
| PT-RS configuration |  | PT-RS is not configured |
| Maximum number of code block groups for ACK/NACK feedback |  | 1 |
| Maximum number of HARQ transmission |  | 4 |
| HARQ ACK/NACK bundling |  | Multiplexed |
| Redundancy version coding sequence |  | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity |
| Symbols for all unused REs |  | OP.1 FDD as defined in Annex A.5.1.1OP.1 TDD as defined in Annex A.5.2.1 |
| Physical signals, channels mapping and precoding |  | As specified in Annex B.4.1 |
| Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.Note 3: Refer to Table 7.4.1.5.3-1 in [9] |

##### 5.2.3.1.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.3.1.2-3, with the addition of test parameters in Table 5.2.3.1.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.2-1.

Table 5.2.3.1.2-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.3.1.2-2: Test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | FDD |
| Active DL BWP index |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S)  |  | 2 |
| Length (L) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| NZP CSI-RS for CSI acquisition | OFDM symbols in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI acquisition | Subcarrier index in the PRB used for CSI-RS |  | (k0, k1, k2, k3)=(2, 4, 6, 8) |
| Number of CSI-RS ports (X) |  | 8 |
| CSI-RS periodicity | Slots | 5 |
| Number of HARQ Processes |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | 2 |

Table 5.2.3.1.2-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
|  |  | **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 1-1 | R.PDSCH.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 70 | 9.1 |

## 5.3 PDCCH demodulation requirements

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

The parameters specified in Table 5.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 5.3-1: Common test Parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 1) |  | 0 |
| DL BWP configuration #1 | Cyclic prefix |  | Normal |
| RB offset | RBs | 0 |
| Common serving cell parameters | Physical Cell ID |  | 0 |
| SSB position in burst |  | First SSB in Slot #0 |
| SSB periodicity | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring |  | Each slot |
| Number of PDCCH candidates |  | 1 |
| Frequency domain resource allocation for CORESET |  | Start from RB = 0 with contiguous RB allocation |
| TCI state |  | TCI state #1 |
| CSI-RS for tracking | First subcarrier index in the PRB used for CSI-RS (*k0*) |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) |  | CSI-RS resource 1: 4CSI-RS resource 2: 8CSI-RS resource 3: 4CSI-RS resource 4: 8 |
| Number of CSI-RS ports (*X*) |  | 1 |
| CDM Type |  | No CDM |
| Density (*ρ*) |  | 3 |
| CSI-RS periodicity | Slots | 15 kHz SCS: 2030 kHz SCS: 40 |
| CSI-RS offset | Slots | 15 kHz SCS:10 for CSI-RS resource 1 and 211 for CSI-RS resource 3 and 430 kHz SCS:20 for CSI-RS resource 1 and 221 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size /4)\*4 |
| QCL info |  | TCI state #0 |
| TCI state #0 | Type 1 QCL information  | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | Type 1 QCL information  | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| PDCCH & PDCCH DMRS Precoding configuration |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination with REG bundling granularity for number of Tx larger than 1 |
| Physical signals, channels mapping and precoding |  | As specified in Annex B.4.1 |
| Symbols for all unused REs |  | OP.1 FDD as defined in Annex A.5.1.1OP.1 TDD as defined in Annex A.5.2.1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | 2 for FDD.For TDD, specific to each TDD UL-DL pattern and as defined in Annex A.1.2. |
| Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.Note 2: The high layer parameter *precoderGranularity* equals to *sameAsREG-bundle* as defined in clause 7.4.1.3 of TS 38.211 [9]. |

## 7.2 PDSCH demodulation requirements

The parameters specified in Table 7.2-1 are valid for all PDSCH demodulation tests unless otherwise stated.

Table 7.2-1: Common Test Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| PDSCH transmission scheme |  | Transmission scheme 1 |
| PTRS *epre-Ratio* |  | 0 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | RBs | 0 |
| Subcarrier spacing | kHz | 60 or 120 |
| DL BWP configuration #1 | Cyclic prefix |  | Normal |
| RB offset | RBs | 0 |
| Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Common serving cell parameters | Physical Cell ID |  | 0 |
| SSB position in burst |  | First SSB in Slot #0 |
| SSB periodicity | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring |  | Each slot |
| Symbols with PDCCH |  | 0 |
| Number of PRBs in CORESET |  | Table 7.2-2 for tested channel bandwidth and subcarrier spacing |
| Number of PDCCH candidates and aggregation levels |  | 1/AL8 |
| CCE-to-REG mapping type |  | Non-interleaved |
| DCI format |  | 1\_1 |
| TCI state |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration |  | Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 |
| Cross carrier scheduling |  | Not configured |
| CSI-RS for tracking | 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 PRB used for CSI-RS (*l0*) |  | 6 for CSI-RS resource 1 and 310 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 | 60 kHz SCS: 80 for CSI-RS resource 1,2,3,4120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | Slots | 60 kHz SCS: 40 for CSI-RS resource 1 and 241 for CSI-RS resource 3 and 4120 kHz SCS:80 for CSI-RS resource 1 and 281 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4)\*4 |
| QCL info |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Row index(Note 3) |  | 3 for 2 CSI-RS ports and 5 for 4 CSI-RS ports |
| First subcarrier index in the PRB used for CSI-RS (*k0*) |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) |  | 12 |
| Number of CSI-RS ports (*X*) |  | 2 |
| CDM Type |  | FD-CDM2 |
| Density (*ρ*) |  | 1 |
| CSI-RS periodicity | Slots | 60 kHz SCS: 80120 kHz SCS: 160 |
| CSI-RS offset |  | 0 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4) \*4 |
| QCL info |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Row index(Note 3) |  | 5 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | 4 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) |  | 12 |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (*ρ*) |  | 1 |
| CSI-RS periodicity | Slots | 60 kHz SCS: 80120 kHz SCS: 160 |
| CSI-RS offset |  | 0 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4) \*4 |
| CSI-RS for beam refinement | First subcarrier index in the PRB used for CSI-RS  |  | k0=0 for CSI-RS resource 1,2 |
| First OFDM symbol in the PRB used for CSI-RS  |  | l0 = 8 for CSI-RS resource 1l0 = 9 for CSI-RS resource 2 |
| Number of CSI-RS ports (X) |  | 1 for CSI-RS resource 1,2 |
| CDM Type |  | 'No CDM' for CSI-RS resource 1,2 |
| Density (ρ) |  | 3 for CSI-RS resource 1,2 |
| CSI-RS periodicity | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2120 kHz SCS: 160 for CSI-RS resource 1,2 |
| CSI-RS offset | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4)\*4 |
| Repetition |  | ON |
| QCL info |  | TCI state #1 |
| PDSCH DMRS configuration | Antenna ports indexes |  | {1000} for Rank 1 tests{1000, 1001} for Rank 2 tests |
| Position of the first DMRS for PDSCH mapping type A |  | 2 |
| Number of PDSCH DMRS CDM group(s) without data |  | 1 |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| PTRS configuration | Frequency density (*KPT-RS*) |  | 2 |
| Time density (*LPT-RS*) |  | 1 |
| Resource Element Offset |  | 2 |
| Maximum number of code block groups for ACK/NACK feedback |  | 1 |
| Maximum number of HARQ transmission |  | 4 |
| HARQ ACK/NACK bundling |  | Multiplexed |
| Redundancy version coding sequence |  | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, andwith Wideband granularity |
| Symbols for all unused REs |  | OP.1 FDD as defined in Annex A.5.1.1OP.1 TDD as defined in Annex A.5.2.1 |
| Physical signals, channels mapping and precoding |  | As specified in Annex B.4.1 |
| Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing.Note 3: Refer to Table 7.4.1.5.3-1 in [9] |

## 7.3 PDCCH demodulation requirements

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

The parameters specified in Table 7.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 7.3-1: Common test Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 1) |  | 0 |
| DL BWP configuration #1 | Cyclic prefix |  | Normal |
| Common serving cell parameters | Physical Cell ID |  | 0 |
| SSB position in burst |  | First SSB in Slot #0 |
| SSB periodicity | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring |  | Each slot |
| Number of PDCCH candidates |  | 1 |
| Frequency domain resource allocation for CORESET |  | Start from RB = 0 with contiguous RB allocation |
| TCI state |  | TCI state #1 |
| CSI-RS for tracking | First subcarrier index in the PRB used for CSI-RS (k0) |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | CSI-RS resource 1: 4CSI-RS resource 2: 8CSI-RS resource 3: 4CSI-RS resource 4: 8 |
| Number of CSI-RS ports (X) |  | 1 |
| CDM Type |  | No CDM |
| Density (ρ) |  | 3 |
| CSI-RS periodicity | Slots | 160 |
| CSI-RS offset | Slots | 80 for CSI-RS resource 1 and 281 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4)\*4 |
| QCL info |  | TCI state #0 |
| NZP CSI-RS for beam refinement | First subcarrier index in the PRB used for CSI-RS (k0) |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | CSI-RS resource 1: 8CSI-RS resource 2: 9 |
| Number of CSI-RS ports (X) |  | 1 |
| CDM Type |  | No CDM |
| Density (ρ) |  | 3 |
| CSI-RS periodicity | Slots | 120 kHz SCS: 160 for CSI-RS resource 1,2 |
| CSI-RS offset | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation |  | Start PRB 0Number of PRB = ceil(BWP size/4) \*4 |
| Repetition |  | ON |
| QCL info |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration |  | Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| Symbols for all unused REs |  | OP.1 FDD as defined in Annex A.5.1.1OP.1 TDD as defined in Annex A.5.2.1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.3. |
| Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.Note 2: The high layer parameter *precoderGranularity* equals to *sameAsREG-bundle* as defined in clause 7.4.1.3 of TS 38.211 [9]. |