**3GPP TSG RAN WG4 Meeting #104-e R4-2215100**

**E-meeting, 15 Aug. 2022 – 26 Aug. 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  |  | **CR** |  | **rev** | **1** | **Current version:** | **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:***  | Draft CR on CSI-RS-based BFD and SSB-based LR for SCell with Non-DRX in EN-DC scenario |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_feMIMO-Perf |  | ***Date:*** |  2022-08-26 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *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:*** | RAN4 introduced core requirements for TRP specific beam failure detection and link recovery procedure as part of the FeMIMO WI. RAN4 needs to introduce the test cases to test the core requirements of TRP specific beam failure detection.  |
|  |  |
| ***Summary of change:*** | Test case for TRP specific beam failure detection and link recovery procedure for SCell in EN-DC is introduced.  |
|  |  |
| ***Consequences if not approved:*** | TC for TRP specific beam failure detection and LR procedures will be missing.  |
|  |  |
| ***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 ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | R4-2213947 |

<Start of Change 1>

A.4.5.5.X1 EN-DC TRP specific Beam Failure Detection and Link Recovery Test for FR1 SCell configured with CSI-RS-based BFD and SSB-based LR in non-DRX mode

A.4.5.5. X1.1 Test Purpose and Environment

The scenario is EN-DC and the NR SCell in the test contains two TRPs (i.e., TRP0 and TRP1), and each TRP is associated with different PCI, different BFD-RS and CBD-RS. CSI-RS is configured for the BFD-RS and SSB is configured as LR or CBD-RS. That means each TRP is configured with different CSI-RS and SSB for BFD and CBD respectively.

The purpose of this test is to verify that the UE properly detects the CSI-RS-based beam failure on the TRP using the respective configured BFD set for TRP0 and for TRP1. After the BFD is detected for the TRP, the test further verifies whether the UE performs the correct SSB-based link recovery based on the configured beam candicate set for TRP0 and for TRP1. In the test one TRP (TRP0) is provided with schedulingRequestID-BFR-r17 and other TRP (TRP1) is not provided with scheduling request ID. This test will partly verify the beam failure detection and link recovery for an FR1 serving cell requirements in clause 8.18.

Supported test configuration are provided in Table A.4.5.5.X1.1-1, general test parameters for FR1 SCell is provided in Table A.4.5.5.X1.1-2, and Cell specific test parameter are provided in Table A.4.5.5.X1.1-3. There are three cells in the test, cell 1 is the E-UTRAN PCell, cell 2 is the NR PSCell and cell 3 is the NR SCell. CSI report for SCell (cell 3) are transmitted on PSCell (cell 2).

The test consists of five successive time periods, with time duration of T1, T2, T3, T4 and T5 respectively. Figure A.4.5.5.X1.1-1 shows the SNR of the CSI-RS in set q0,0 in the TRP0 to emulate beam failure. Figure A.4.5.5.X1.1-1 additionally shows the variation of the downlink L1-RSRP of the SSB in set q10 and q11 of the candidate beam used for link recovery. Prior to the start of the time duration T1, the UE shall be fully synchronized to cell 1, cell 2 and cell3. The UE shall be configured for periodic CSI reporting with a reporting periodicity of 5 ms. In the test, DRX configuration is not enabled.

**Table A.4.5.5.X1.1-1: Supported test configurations for FR1 PCell and SCell**

|  |  |
| --- | --- |
| **Configuration** | **Description** |
| 1 | LTE FDD, NR 15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode |
| 2 | LTE FDD, NR 15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode |
| 3 | LTE FDD, NR 30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode |
| 4 | LTE TDD, NR 15 kHz SSB SCS, 10 MHz bandwidth, FDD duplex mode |
| 5 | LTE TDD, NR 15 kHz SSB SCS, 10 MHz bandwidth, TDD duplex mode |
| 6 | LTE TDD, NR 30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode |
| Note: The UE is only required to pass in one of the supported test configurations in FR1 |

**Table A.4.5.5.X1.1-2:** **General test parameters for FR1 SCell for beam failure detection and link recovery testing in non-DRX mode**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | **Comment** |
|  |  | **Test 1** | Same configuration for both TRP whereever applicbale |
| Active PCell  |  | Cell 1 |  |
| E-UTRA RF Channel Number |  | 1 |  |
| Active PSCell  |  | Cell 2 |  |
| RF Channel Number for PSCell |  | 2 |  |
| Active SCell  |  | Cell 3 |  |
| RF Channel Number for SCell |  | 3 |  |
| Duplex mode | Config 1, 4 |  | FDD |  |
|  | Config 2, 3, 5, 6 |  | TDD |  |
| BW channel | Config 1, 4 |  | 10: NRB,c = 52 |  |
|  | Config 2, 5 | MHz | 10: NRB,c = 52 |  |
|  | Config 3, 6 |  | 40: NRB,c = 106 |  |
| DL initial BWP configuration | Config 1, 2, 3, 4, 5, 6 |  | DLBWP.0.1 |  |
| DL dedicated BWP configuration | Config 1, 2, 3, 4, 5, 6 |  | DLBWP.1.1 |  |
| UL initial BWP configuration | Config 1, 2, 3, 4, 5, 6 |  | ULBWP.0.1 |  |
| UL dedicated BWP configuration | Config 1, 2, 3, 4, 5, 6 |  | ULBWP.1.1 |  |
| TDD Configuration | Config 1, 4 |  | Not Applicable |  |
|  | Config 2, 5 |  | TDDConf.1.1 |  |
|  | Config 3, 6 |  | TDDConf.2.1 |  |
| CORESET  | Config 1, 4 |  | CR.1.1 FDD | A.3.1.2 |
| Reference Channel | Config 2, 5 |  | CR.1.1 TDD |  |
|  | Config 3, 6 |  | CR.2.1 TDD |  |
| SSB Configuration | Config 1, 4 |  | SSB.1 FR1 | A.3.10 |
|  | Config 2, 5 |  | SSB.1 FR1 | Same configuration for both TRP |
|  | Config 3, 6 |  | SSB.2 FR1 |  |
| SMTC Configuration | Config 1, 2, 3, 4, 5, 6 |  | SMTC.1 | A.3.11, Same configuration for both TRP |
| PDSCH/PDCCH  | Config 1, 2, 4, 5 | kHz | 15  |  |
| subcarrier spacing | Config 3, 6 |  | 30  |  |
| PRACH Configuration | Config 1, 2, 4, 5 |  | Table A.3.8.2.2-1 |  |
| Config 3, 6 |  | Table A.3.8.2.2-1 |  |
| csi-RS-Index assigned as beam failure detection RS in set q00 in activated SCell |  | 0 |  |
| csi-RS-Index assigned as beam failure detection RS in set q01 in activated SCell |  | 2 |  |
| OCNG parameters |  | OP.1 | A.3.2.1 |
| CP length  |  | Normal |  |
| Correlation Matrix and Antenna Configuration |  | 2x2 Low |  |
| Beam failure  | DCI format |  | 1-0 |  |
| detection transmission parameters | Number of Control OFDM symbols |  | 2 |  |
|  | Aggregation level  | CCE | 8 |  |
|  | Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | dB | 0 |  |
|  | Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | dB | 0 |  |
|  | DMRS precoder granularity |  | REG bundle size |  |
|  | REG bundle size |  | 6 |  |
| DRX |  | OFF |  |
| Gap pattern ID  |  | N.A. |  |
| schedulingRequestID-BFR-r17 |  | Configured, 1-2 |  |
| schedulingRequestID-BFR2-r17 |  | absent | When the field is absent, the random access procedure will be triggered for TRP BFR |
| Periodicity of PUCCH for SR configuration for BFR on TRP0 | Slot | 5 |  |
| SSB Index assigned as CBD RS (q10) in activated SCell |  | 1 |  |
| SSB Index assigned as CBD RS (q11) in activated SCell |  | 3 |  |
| rlmInSyncOutOfSyncThreshold |  | absent | When the field is absent, the UE applies the value 0. (Table 8.1.1-1). |
| rsrp- | Config 1, 2, 4, 5 | dBm/SCS  | -98 | Threshold used  |
| ThresholdBFR | Config 3, 6 |  | -95 | for Qin\_LR\_SSB |
| powerControlOffsetSS |  | db0 | Used for deriving rsrp-ThresholdCSI-RS |
| beamFailureInstanceMaxCount |  | n1 | see TS 38.321 [7], clause 5.17 |
| beamFailureDetectionTimer |  | pbfd4 | see TS 38.321 [7], clause 5.17 |
| CBD-RS (CSI-RS) configuration for q10 in activated SCell | Config 1, 4 |  | SSB.3 FR1 | A.3.14 |
| Config 2, 5 | SSB.3 FR1 |
| Config 3, 6 | SSB.4 FR1 |
| CBD-RS (CSI-RS) configuration for q11 in activated SCell | Config 1, 4 |  | SSB.7 FR1 | A.3.14 |
| Config 2, 5 | SSB.7 FR1 |
| Config 3, 6 | SSB.8 FR1 |
| BFD-RS (CSI-RS)  | Config 1, 4 |  | CSI-RS.1.2 FDD | A.3.14 |
| configuration for q00 in activated SCell | Config 2, 5 |  | CSI-RS.1.2 TDD |  |
|  | Config 3, 6 |  | CSI-RS.2.2 TDD |  |
| BFD-RS (CSI-RS) configuration for q01 in activated SCell | Config 1, 4 |  | CSI-RS.1.7 FDD | A.3.14 |
| Config 2, 5 | CSI-RS.1.6 TDD |
| Config 3, 6 | CSI-RS.2.7 TDD |
| CSI-RS  | Config 1, 4 |  | CSI-RS.1.1 FDD | A.3.14 |
| configuration for | Config 2, 5 |  | CSI-RS.1.1 TDD |  |
| CSI reporting | Config 3, 6 |  | CSI-RS.2.1 TDD |  |
| TRS configuration | Config 1, 4 |  | TRS.1.1 FDD |  |
|  | Config 2, 5 |  | TRS.1.1 TDD |  |
|  | Config 3, 6 |  | TRS.1.2 TDD |  |
| csi-RS-Index  | Config 1, 4 |  | CSI-RS.1.2 FDD | A.3.14 |
| assigned as RLM | Config 2, 5 |  | CSI-RS.1.2 TDD |  |
| RS in PSCell | Config 3, 6 |  | CSI-RS.2.2 TDD |  |
| T310 Timer | ms | 1000 |  |
| N310 |  | 2 |  |
| T1 | s | 1 | During this time the the UE shall be fully synchronized to cell 1 |
| T2 | s | 0.18 |  |
| T3 | s | 0.14 |  |
| T4 | s | 0 |  |
| T5 | s | 0.17 |  |
| D1 | s | 0.13 |  |
| Note 1: UE-specific PDCCH is not transmitted after T1 starts. |

**Table A.4.5.5.X1.1-3: Cell specific test parameters for FR1 PSCell and SCell for beam failure detection and link recovery testing in non-DRX mode**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Cell2** | **TRP 0/1 Cell3** |
|  |  | **T1 to T5** | **T1** | **T2** | **T3** | **T4** | **T5** |
| EPRE ratio of PDCCH DMRS to SSS | dB |  |  |
| EPRE ratio of PDCCH to PDCCH DMRS | dB |  |  |
| EPRE ratio of PBCH DMRS to SSS | dB |  |  |
| EPRE ratio of PBCH to PBCH DMRS | dB |  |  |
| EPRE ratio of PSS to SSS | dB | 0 | 0 |
| EPRE ratio of PDSCH DMRS to SSS  | dB |  |  |
| EPRE ratio of PDSCH to PDSCH DMRS | dB |  |  |
| EPRE ratio of OCNG DMRS to SSS | dB |  |  |
| EPRE ratio of OCNG to OCNG DMRS | dB |  |  |
| SNR\_CSI-RS of set q00  | Config 1, 4 | dB | 5 | 5 | -3 | -12 | -12 | -12 |
|  | Config 2, 5 |  | 5 | 5 | -3 | -12 | -12 | -12 |
|  | Config 3, 6 |  | 5 | 5 | -3 | -12 | -12 | -12 |
| SNR\_CSI-RS of set q01 | Config 1, 4 |  | 555 | 555 | 555 | 555 | 555 | 555 |
| Config 2, 5 |
| Config 3, 6 |
| SNR\_SSB of set q10  | Config 1, 4 | dB | -10 | -10 | -10 | 10 | 10 | 10 |
|  | Config 2, 5 |  | -10 | -10 | -10 | 10 | 10 | 10 |
|  | Config 3, 6 |  | -10 | -10 | -10 | 10 | 10 | 10 |
| SSB\_RP of set q10 | Config 1, 4 | dBm/SCS kHz | -108 | -108 | -108 | -88 | -88 | -88 |
|  | Config 2, 5 |  | -108 | -108 | -108 | -88 | -88 | -88 |
|  | Config 3, 6 |  | -105 | -105 | -105 | -85 | -85 | -85 |
|  | Config 1, 4 | dBm/15 kHz | -98 | -98 |
|  | Config 2, 5 |  | -98 | -98 |
|  | Config 3, 6 |  | -98 | -98 |
| Propagation condition |  | TDL-C 300ns 100Hz | TDL-C 300ns 100Hz |
| Note 1: OCNG shall be used such that the resources in Cell 1 are fully allocated and a constant total transmitted power spectral density is achieved for all OFDM symbols.Note 2: The uplink resources for CSI reporting are assigned to the UE prior to the start of time period T1.Note 3: NZP CSI-RS resource set configuration for CSI reporting are assigned to the UE prior to the start of time period T1.Note 4: VoidNote 5: The timers and layer 3 filtering related parameters are configured prior to the start of time period T1.Note 6: The signal contains PDCCH for UEs other than the device under test as part of OCNG.Note 7: SNR levels correspond to the signal to noise ratio over the REs carrying CSI-RS.Note 8: The SNR in time periods T1, T2, T3, T4 and T5 is denoted as SNR1, SNR2 and SNR3 respectively in figure A.4.5.5.1.1-1.Note 9: The SNR values are specified for testing a UE which supports 2RX on at least one band. For testing of a UE which supports 4RX on all bands, the SNR during T3 is modified as specified in clause [A.3.6]. |



**Figure A.4.5.5.X1.1-1: SNR and L1-RSRP variation for beam failure detection and link recovery testing for TRP0 in non-DRX mode**

A.4.5.5.X1.2 Test Requirements

The UE behaviour during time durations T1, T2, T3, T4 and T5 shall be as follows:

During the time duration T1 and T2, the UE shall transmit uplink signal at least in all subframes configured for CSI transmission on Cell 2.

During the period from time point A to time point B the UE shall transmit uplink signal in Cell 2 in all uplink slots configured for CSI transmission according to the configured periodic CSI reporting for Cell 2.

During T3 the UE shall detect beam failure on both TRP0 and TRP 1 and initiate link recovery. During T4 and T5 the UE measures and evaluate beam candidate from beam candidate set q1,0 and q1,1.

For TRP0, no later than time point F occurring no later than D1 = [60] ms after the start of T5, the UE shall transmit PUCCH with LRR, followed by BFR MAC CE containing a beam associated with the candidate beam set q1,0. The UE shall not transmit PUCCH with an LRR with the candidate beam set q1,0 earlier than time point B.

Test is concluded once the test equipment has received the BFR MAC CE from the UE. The rate of correct events observed during repeated tests shall be at least 90%.

<End of Change 1>