**3GPP TSG- Meeting #**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | 1 | **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:***  |  |
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| ***Source to WG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** |  |
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| ***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:*** | Intoduction of link recovery requiremenst for NR-U. |
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| ***Summary of change:*** | Introducition of SSB based link recovery procedure when CCA is used in FR1 |
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| ***Consequences if not approved:*** | Link recovery requirements are missing for NR-U. |
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| ***Clauses affected:*** | 8.5A (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.533 ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

## 8.5A Link Recovery Procedures when CCA is used on target frequency

### 8.5A.1 Introduction

The requirements for link recovery procedure in the clause apply when CCA is used on a serving frequency on the downlink.

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set $\overbar{q}\_{0}$ as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA operation mode,

- PSCell in EN-DC operation mode.

The RS resource configurations in the set $\overbar{q}\_{0}$ can be periodic SSBs. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5A.2 and 8.5A.3 if UE does not have set $\overbar{q}\_{0}$.

On each RS resource configuration in the set $\overbar{q}\_{0}$, the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams.

The threshold Qout\_LR is defined as the level at which the downlink radio level link of a given resource configuration on set $\overbar{q}\_{0}$ cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5A.2.1-1.

Upon request the UE shall deliver configuration indexes from the set $\overbar{q}\_{1}$ as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The RS resource configurations in the set $\overbar{q}\_{1}$ can be periodic SSBs. UE is not required to perform candidate beam detection outside the active DL BWP.

### 8.5A.2 Requirements for SSB based beam failure detection

#### 8.5A.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set $\overbar{q}\_{0}$ configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5A.2.2.

**Table 8.5A.2.1-1: PDCCH transmission parameters for beam failure instance**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER** |
| DCI format | TBD |
| Number of control OFDM symbols | TBD |
| Aggregation level (CCE) | TBD |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | TBD |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | TBD |
| Bandwidth (PRBs) | TBD |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | TBD |
| REG bundle size | TBD |
| CP length | Normal |
| Mapping from REG to CCE | TBD |

#### 8.5A.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set $\overbar{q}\_{0}$ estimated over the last TEvaluate\_BFD\_SSB\_CCA ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB\_CCA ms period.

The value of TEvaluate\_BFD\_SSB\_CCA is defined in Table 8.5A.2.2-1 for FR1.

For FR1,

- $P=\frac{1}{1-\frac{T\_{SSB}}{MRGP}}$, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

**Table 8.5A.2.2-1: Evaluation period TEvaluate\_BFD\_SSB\_CCA for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB\_CCA (ms)**  |
| no DRX | Max(50, Ceil((5 + LBFD) × P) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × (5 + LBFD) P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil((5 + LBFD) × P) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set $\overbar{q}\_{0}$. TDRX is the DRX cycle length.Note 2: LBFD is the number of SSBs not avaialbe at the UE during TEvaluate\_BFD\_SSB\_CCA where LBFD ≤ LBFD,max.Note 3: FFS for LBFD.  |

#### 8.5A.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

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### 8.5A.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set $\overbar{q}\_{0}$ is worse than Qout\_LR, layer 1 of the UE shall send a beam failure instance indication to the higher layers. A layer 3 filter may be applied to the beam failure instance indications as specified in TS 38.331 [2].

The beam failure instance evaluation for the RS resources in set $\overbar{q}\_{0}$ shall be performed as specified in clause 6 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD\_CCA.

When DRX is not used, TIndication\_interval\_BFD\_CCA is max(2ms, TSSB-RS,M) ), where TSSB-RS,M is the shortest periodicity of all RS resources in set $\overbar{q}\_{0}$ for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set $\overbar{q}\_{0}$ .

When DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD\_CCA = Max(1.5 × DRX\_cycle\_length, 1.5 × TSSB-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD\_CCA = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

### 8.5A.5 Requirements for SSB based candidate beam detection

#### 8.5A.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set $\overbar{q}\_{1}$ configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5A.5.2.

#### 8.5A.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB\_CCA ms period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex Table B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.5A.5.2-1 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB\_CCA is defined in Table 8.5A.5.2-1 for FR1.

Where,

For FR1,

- $P=\frac{1}{1-\frac{T\_{SSB}}{MRGP}}$, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB,

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

Table 8.5A.5.2-1: Evaluation period TEvaluate\_CBD\_SSB\_CCA for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB\_CCA (ms)**  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil((3 + LCBD) × P) × TSSB) |
| DRX cycle > 320ms | Ceil((3 + LCBD) × P) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set $\overbar{q}\_{1}$. TDRX is the DRX cycle length.Note 2: LCBD is the number of SSBs not avaialbe at the UE during TEvaluate\_CBD\_SSB\_CCA where LBFD ≤ LCBD,max.Note 3: LCBD,max=TBD for Max(TDRX, TSSB) ≤ 40 assuming TDRX=0 for non-DRX, LCBD,max=TBD for 40 < Max(TDRX, TSSB) ≤ 320, LCBD,max=TBD for TDRX > 320. |

#### 8.5A.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions;

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

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### 8.5A.7 Scheduling availability of UE during beam failure detection

Scheduling availability restrictions when the UE is performing beam failure detection are described in the following clauses.

#### 8.5A.7.1 Scheduling availability of UE performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH on FR1

In this section, the same requirements apply as in Section 8.5.7.1.

#### 8.5A.7.2 Scheduling availability of UE performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

In this section, the same requirements apply as in Section 8.5.7.2.

### 8.5A.8 Scheduling availability of UE during candidate beam detection

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for candidate beam detection are described in the following clauses.

#### 8.5A.8.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

In this section, the same requirements apply as in Section 8.5.8.1.

#### 8.5A.8.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

In this section, the same requirements apply as in Section 8.5.8.2.

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