**3GPP TSG-RAN WG4 Meeting #101bis-e *R4-2207121***

**Online, January 17–25, 2022**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **DraftCR** | **rev** | **-** | **Current version:** | **17.4.0** |  |
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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:***  | Draft Big CR: RRM requirements for Rel-17 NR UE Power Saving Enhancements |
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| ***Source to WG:*** | MediaTek Inc. |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_UE\_pow\_sav\_enh-Core |  | ***Date:*** | 2022-01-26 |
|  |  |  |  |  |
| ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | On Top of the endorced Big CR R4-2202759, add the following CR endorced in RAN4 #102-e meeting, for the requirement of Rel-17 NR UE Power Saving Enhancements.

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| --- | --- |
| R4-2206910 | Draft CR Minimum requirement for CSI-RS based beam failure detection for UE configured with relaxed measurement criterion |
| R4-2206911 | CR on TS38.133 for applicability of RLM measurement relaxation |
| R4-2206912 | DraftCR on SSB based relaxed RLM requirements |
| R4-2206913 | draft CR on CSI-RS RLM requirements relaxation for R17 UE power saving |
| R4-2206914 | Draft CR to TS 38.133: Applicability of relaxed BFD requirements |
| R4-2206915 | Draft CR for TS 38.133 Minimum requirement for SSB based BFD for UE configured with relaxed measurement criterion |
| R4-2205850 | Clause title change on big CR |

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|  |  |
| ***Summary of change:*** | * **Change#1**:introduce a new clause, 8.1.1.1, for the applicability of RLM measurement relaxation (R4-2206911)
* **Change#2**: introduce a new clause, 8.1.2.X, for the relaxed requirements for SSB based radio link monitoring (R4-2206912)
* **Change#3**: introduce a new clause, 8.1.3.X, for the relaxed requirements for CSI-RS based radio link monitoring (-2206913)
* **Change#4**: introduce a new section, on 8.5.1.1, for the applicability of RLM measurement relaxation (R4-2206914)
* **Change#5**: introduce a new clause, 8.5.2.X, for the relaxed requirements for SSB based BFD (R4-2206915)
* **Change#6**: introduce a new clause, 8.5.3.X, to introduce relaxed requirements for CSI-RS based BFD (R4-2206910)
* **Update the tile (**R4-2205850**)**
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| ***Consequences if not approved:*** | The relaxed RLM/BFD requirements are missing for the UEs with RLM/BFD relaxation in R17. |
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| ***Clauses affected:*** | (new sections): 8.1.1.1, 8.1.2.X, 8.1.3.X, 8.5.1.1, 8.5.2.X, 8.5.3.X |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS38.533 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Start of Change #1>

#### 8.1.1.1 Introduction of Requirement on Radio Link Monitoring for UE Configured with Relaxed Measurement Criteria

For the UE supports [connected mode power saving] and configured with explicit signaling [TBD]:

* when the UE is not performing intra-band carrier aggregation configured with CSI-RS based RLM and CSI-RS based BFD on SCell, and
	+ UE has fulfilled good serving cell quality criterion defined in [TBD] if the low mobility criteria is not configured, or
	+ UE is also configured with low mobility criterion defined in [TBD] and UE has fulfilled both good serving cell quality criterion defined in [TBD] and low mobility criterion defined in [TBD].
* when the UE is performing intra-band carrier aggregation configured with CSI-RS based RLM and CSI-RS based BFD on SCell, and
	+ UE has fulfilled good serving cell quality criterion defined in [TBD] for CSI-RS based RLM on SpCell and for CSI-RS based BFD on serving cell if the low mobility criteria is not configured, or
	+ the UE is configured with low mobility criterion defined in [TBD], and UE has fulfilled both good serving cell quality criterion defined in [TBD] and low mobility criterion defined in [TBD] for CSI-RS based RLM on SpCell and for CSI-RS based BFD on a serving cell.

The UE is allowed to apply the relaxed requirements defined in clause 8.1.2.[4] for SSB based radio link monitoring and the relaxed requirements defined in clause 8.1.3.[4] for CSI-RS based radio link monitoring; otherwise, UE shall apply the requirements defined in clause 8.1.2.2 for SSB based radio link monitoring and the requirements defined in clause 8.1.3.2 for CSI-RS based radio link monitoring.

The UE is not allowed to relax RLM measurements and apply the relaxed radio link monitoring provided that at least one of the following conditions is met:

* The UE sends out-of sync indications to the higher layers,
* The UE has triggered T310 timer

<End of Change #1>

<Start of Change #2>

#### 8.1.2.X Minimum requirement of SSB based radio link monitoring for UE fulfilling relaxed measurement criteria

This clause contains minumun requirements for relaxed radio link monitoring based on SSB.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB\_Relax [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB\_Relax [ms] evaluation period.

TEvaluate\_out\_SSB\_Relax is defined in Table 8.1.2.x-1 for FR1.

TEvaluate\_out\_SSB\_Relax is defined in Table 8.1.2.x-2 for FR2 with scaling factor N=8.

The value of P is defined in clause 8.1.2.2.

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

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

**Table 8.1.2.x-1: Evaluation period TEvaluate\_out\_SSB\_Relax for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_out\_SSB\_Relax (ms)**  |
| Max(TDRX,TSSB) ≤80ms | Max(200× K3 NOTE3, Ceil(15 × K1NOTE2 × P) × Max(TDRX,TSSB) NOTE1) |
| 80ms < Max(TDRX,TSSB) ≤160ms | Ceil(15 × P) × Max(TDRX,TSSB) |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length and no longer than 80ms.NOTE 2: K1 = 4 for Max(TDRX,TSSB) ≤40ms and K1 = 2 for 40ms<Max(TDRX,TSSB) ≤80ms.NOTE 3: K3 = K1, if K1 ≤ 2; otherwise K3 = 1. |

**Table 8.1.2.x-2: Evaluation period TEvaluate\_out\_SSB\_Relax for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_out\_SSB\_Relax (ms)**  |
| Max(TDRX,TSSB) ≤80ms | Max(200× K4 NOTE3, Ceil(15 × K2 NOTE2 × P × N) × Max(TDRX,TSSB) NOTE1) |
| 80ms < Max(TDRX,TSSB) ≤160ms | Ceil(15 × P × N) × Max(TDRX,TSSB) |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length and no longer than 80ms.NOTE 2: K2 = 2.NOTE 3: K4 = K2, if K2 ≤ 2; otherwise K4 = 1. |

<End of Change #2>

<Start of Change #3>

#### 8.1.3.X Minimum requirement of CSI-RS based radio link monitoring for UE fulfilling relaxed measurement criteria

This clause contains minimum requirements for relaxed radio link monitoring based on CSI-RS.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_CSI-RS\_Relax [ms] period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS\_Relax [ms] evaluation period.

TEvaluate\_out\_CSI-RS\_Relax is defined in Table 8.1.3.X-1 for FR1.

TEvaluate\_out\_CSI-RS\_Relax is defined in Table 8.1.3.X-2 for FR2 with scaling factor N=1.

The value of P is defined in clause 8.1.3.2.

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

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of Mout used in Table 8.1.3.X-1 and Table 8.1.3.X-2 are defined as:

- Mout = 20, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

Table 8.1.3.X-1: Evaluation period TEvaluate\_out\_CSI-RS\_Relax for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS\_Relax (ms)  |
| Max(TDRX, TCSI-RS) ≤ 80 ms | Max(200 × K3 NOTE3, Ceil(1.5 × Mout × P × K1 NOTE2) × Max(TDRX, TCSI-RS) NOTE1) |
| NOTE1: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length and no longer than 80ms.NOTE2: K1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms, K1 = 4 for MAX(TDRX, TRS) ≤ 40 msNOTE3: K3 = K1, if K1 ≤ 2; K3 = 1 otherwise. |

Table 8.1.3.X-2: Evaluation period TEvaluate\_out\_CSI-RS\_Relax for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS\_Relax (ms)  |
| Max(TDRX, TCSI-RS) ≤ 80 ms | Max(200 × K4 NOTE3, Ceil(1.5 × Mout × P × N × K2 NOTE2) × Max(TDRX, TCSI-RS) NOTE1) |
| NOTE1: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. TDRX is the DRX cycle length and no longer than 80ms.NOTE2: K2 = 2.NOTE3: K4 = K2, if K2 ≤ 2; K4 = 1 otherwise. |

<End of Change #3>

<Start of Change #4>

#### 8.5.1.1 Introduction of Requirement on Link Recovery Procedures for UE configured with relaxed measurement criteria

The relaxed beam failure detection procedures specified in this clause apply provided for the UE supports [connected mode power saving] and configured with dedicated signaling [TBD]:

* when the UE is not performing intra-band carrier aggregation configured with CSI-RS based RLM on SpCell and CSI-RS based BFD on SCell provided that:
* UE has fulfilled good serving cell quality criterion defined in [TBD] if the low mobility criteria is not configured, or
* UE is also configured with low mobility criterion defined in [TBD] and UE has fulfilled both good serving cell quality criterion defined in [TBD] and low mobility criterion defined in [TBD].
* when the UE is performing intra-band carrier aggregation configured with CSI-RS based RLM on SpCell and CSI-RS based BFD on SCell provided that:
* UE has fulfilled good serving cell quality criterion defined in [TBD] for CSI-RS based RLM on SpCell and for CSI-RS based BFD on serving cell if the low mobility criteria is not configured, or
* the UE is configured with low mobility criterion defined in [TBD], and UE has fulfilled both good serving cell quality criterion defined in [TBD] and low mobility criterion defined in [TBD] for CSI-RS based RLM on SpCell and for CSI-RS based BFD on a serving cell.
* Note: the explicit signalling indicates that the low mobility state of the UE, if the low mobility criteria is not configured

The scenario and RS resource configurations in the set  defined in section 8.5.1 apply for this section.

The UE is allowed to apply the relaxed requirements defined in clause 8.5.X.2 for SSB based beam failure detection and the relaxed requirements defined in clause 8.5.X.3 for CSI-RS based beam failure detection; otherwise, UE shall apply the requirements defined in clause 8.5.5 for SSB based beam failure detection and the requirements defined in clause 8.5.3 for CSI-RS based beam failure detection.

The UE is not allowed to apply the relaxed link recovery procedures provided that at least one of the following conditions is met:

* The UE sends a beam failure instance indication to the higher layers,
* The UE has triggered T310 timer.

<End of Change #4>

<Start of Change #5>

#### 8.5.2.X Minimum requirement of SSB based beam failure detection for UE fulfilling relaxed measurement criteria

This clause contains minimum requirements for SSB based relaxed beam failure detection.

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB\_Relax ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB\_Relax ms period.

The value of TEvaluate\_BFD\_SSB\_Relax is defined in Table 8.5.2.X-1 for FR1.

The value of TEvaluate\_BFD\_SSB\_Relax is defined in Table 8.5.2.X-2 for FR2 with scaling factor N=8

The value of P is defined in clause 8.5.2.2.

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

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

**Table 8.5.2.X-1: Evaluation period** **TEvaluate\_BFD\_SSB\_Relax for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB\_Relax (ms)**  |
| Max(TDRX, TSSB) ≤ 80 ms | Max(50 × K3, Ceil(7.5 × K1 × P) × Max(TDRX,TSSB)) |
| 80ms＜Max(TDRX, TSSB) ≤ 160 ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length and no longer than 80ms.Note 2: K1 is the relaxation factor. K1 = 2 for 40ms＜Max(TDRX, TSSB) ≤ 80 ms, K1 = 4 for Max(TDRX, TSSB) ≤ 40 msNote 3: K3 is the relaxation factor for the lower bound. K3 = K1, if 1 < K1 ≤ 2; K3 = 1 otherwise. |

**Table 8.5.2.X-2: Evaluation period TEvaluate\_BFD\_SSB\_Relax for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB\_Relax (ms)**  |
| Mas(TDRX, TSSB) ≤ 80 ms | Max(50 × K4, Ceil(7.5 × K2 × P × N) × Max(TDRX,TSSB)) |
| 80ms＜Max(TDRX, TSSB) ≤ 160 ms | Max(50, Ceil(7.5 × P× N) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length and no longer than 80ms.Note 2: K2 is the relaxation factor. K2 = 2.Note 3: K4 is the relaxation factor for the lower bound. K4 = K2, if 1 < K2 ≤ 2; K4 = 1 otherwise. |

<End of Change #5>

<Start of Change #6>

#### 8.5.3.X Minimum requirement of CSI-RS based beam failure detection for UE fulfilling relaxed measurement criteria

This clause contains the minimum requirements for CSI-RS based relaxed beam failure detection.

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS\_Relax ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS\_Relax ms period.

The value of TEvaluate\_BFD\_CSI-RS\_Relax is defined in Table 8.5.3.X-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS\_Relax is defined in Table 8.5.3.X-2 for FR2 with N=1.

The values of P, MBFD and PBFD is defined in clause 8.5.3.2.

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

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

**Table 8.5.3.X-1: Evaluation period TEvaluate\_BFD\_CSI-RS\_Relax for FR1**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS Relax (ms)  |
| Max(TDRX, TCSI-RS) ≤ 80 ms | Max(50 × K3, Ceil(K1 × 1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| 80 ms < Max(TDRX, TCSI-RS) ≤ 160 ms | Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS) |
| Note 1: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length and no longer than 80ms.Note 2: K1 is the relaxation factor. K1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms, K1 = 4 for MAX(TDRX, TRS) ≤ 40 ms Note 3: K3 is the relaxation factor for the lower bound. K3 = K1, if 1 < K1 ≤ 2; K3 = 1 otherwise. |

**Table 8.5.3.X-2: Evaluation period TEvaluate\_BFD\_CSI-RS\_Relax for FR2**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS Relax (ms)  |
| Max(TDRX, TCSI-RS) ≤ 80ms | Max(50 × K4, Ceil(K2 × 1.5 × MBFD × P× N × PBFD) × Max(TDRX, TCSI-RS)) |
| 80 ms < Max(TDRX, TCSI-RS) ≤ 160 ms | Max(50, Ceil(1.5 × MBFD × P× N × PBFD) × Max(TDRX, TCSI-RS)) |
| Note 1: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length and no longer than 80ms.Note 2: K2 is the relaxation factor. K2 = 2 Note 3: K4 is the relaxation factor for the lower bound. K4 = K2, if 1 < K2 ≤ 2; K4 = 1 otherwise. |

<End of Change #6>