3GPP TSG-RAN WG4 Meeting # 102-e R4-2205624

Electronic Meeting, February 21 – 3 March, 2022

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  |  | **CR** |  | **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:*** | Big CR for RedCap for TS 38.133 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_redcap-Core | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***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 can be 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:*** | | Big CR to collecting all endorsed CRs at RAN4#102-e. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This CR is based on the following endorsed CRs.  **From RAN4#102-e**:  Change #1: Definitions  R4-2206959, “Draft CR for Definitions, symbols and abbreviations for Redcap”, vivo  Change #2: Applicability of requirements  R4-2206959, “Draft CR for Definitions, symbols and abbreviations for Redcap”, vivo  Change #3: IDLE mode requirements  R4-2206955, "Draft CR on RRC\_IDLE mode requirements for RedCap for TS 38.133", Ericsson  Change #4: IDLE mode relaxation  R4-2206955, "Draft CR on RRC\_IDLE mode requirements for RedCap for TS 38.133", Ericsson  Change #5: INACTIVE mode requirements  R4-2206953, "Draft CR on measurements requirements for inactive state Redcap UE", OPPO  R4-220xxxx, "xxxx", Huawei  Placeholder for adding following changes:  - Measurement and evaluation of serving cell of RedCap UE in INACTIVE mode  - Measurements of intra-frequency NR cells of RedCap UE in INACTIVE mode  - Measurements of inter-frequency NR cells of RedCap UE in INACTIVE mode  R4-2206958, "Draft CR for maximum interruption in paging reception for Redcap", vivo  Change #6: INACTIVE mode measurement relaxation  R4-2206956, "Draft CR on RRC\_INACTIVE mode requirements for RedCap for TS 38.133", Ericsson  Change #7: INACTIVE mode Small Data Transmission  R4-2206956, "Draft CR on RRC\_INACTIVE mode requirements for RedCap for TS 38.133", Ericsson  Change #8: Handover  R4-2206965, "Draft CR on mobility requirements for Redcap UE", Huawei, HiSilicon  Change #9: RRC re-establishment  R4-2206965, "Draft CR on mobility requirements for Redcap UE", Huawei, HiSilicon  Change #10: Random access  R4-2206965, "Draft CR on mobility requirements for Redcap UE", Huawei, HiSilicon  Change #11: RRC connection release with redirection  R4-2206965, "Draft CR on mobility requirements for Redcap UE", Huawei, HiSilicon  Change #12: UE transmit timing  R4-2206960, "Draft CR on timing requirements for RedCap UE", Xiaomi  Change #13: Radio Link Monitoring  R4-2206963, "DraftCR on reduced capability Ues for RLM for RedCap", MediaTek Inc.  Change #14: Link Recovery Procedures  R4-2206964, "Draft CR for Link Recovery Procedures for Redcap", vivo  Change #15: Active BWP switch, TCI state switch  R4-220xxxx, "xxxxx", CMCC  Placeholder for BWP switch delay requirements  Placeholder for TCI state switching delay requirements switching delay requirements  Change #16: Uplink spatial relation switch delay  R4-220xxxx, "xxxxx", Ericsson  Placeholder for Uplink sptial relation switch delay requirements  Change #17: UE-specific CBW  R4-220xxxx, "xxxxx", CMCC  Placeholder for UE-specific CBW change requirements  Change #18: CONNECTED mode: general measurements  R4-2206968, "DraftCR on reduced capability Ues for general measurements and intra-frequency", MediaTek Inc.   * Measurement gap, measurement capabiliyt, CSSF, transition requirements   Change #19: CONNECTED mode: intra-frequency measurements  R4-2206968, "DraftCR on reduced capability Ues for general measurements and intra-frequency", MediaTek Inc.   * Intra-frequency measurements   Change #20: CONNECTED mode: inter-frequency measurements  R4-2206969, "DraftCR on reduced capability Ues for inter-frequency and inter-RAT measurements", MediaTek Inc.   * Inter-frequency measurements   Change #21: CONNECTED mode: inter-RAT measurements  R4-2206969, "DraftCR on reduced capability Ues for inter-frequency and inter-RAT measurements", MediaTek Inc.   * Inter-RAT measurements   Change #22: CONNECTED mode: L1-RSRP  R4-2206970, "Draft CR – Introducing L1-RSRP requirements for RedCap UEs", Nokia, Nokia Shanghai Bell   * L1-RSRP measurement for reporting   Change #23: CONNECTED mode: Measurements with autonomous gap  R4-2206972, "Introduction of RedCap UE in clause 9.11A", Nokia, Nokia Shanghai Bell   * CGI identification of an NR Cell   *Big CR editor note: More sections can be added based on agreements in other areas.* | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | RedCap core requirements will be missing in the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1,  New sections: 3.6.11, 4.2B, 5.1B, 6.1C, 6.2.1B, 6.2.2B, 6.2.3A, 7.1A, 7.2A, 7.3A, 8.1B, 8.5B, 8.6A, 8.10B, 8.12A, 8.13A, 9.1A, 9.2B, 9.3B, 9.4A, 9.5B, 9.11A | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Big draft CR template was endorsed in R4-2202762 at RAN4#101-bis-e. | | | | | | | | |

**--- Start of change 1 ---**

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [11] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [11].

**1 Rx RedCap**: Redcap UE for which requirements are derived assuming 1 Rx branch.

**2 Rx Redcap**: Redcap UE for which requirements are derived assuming 2 Rx branches.

**Active DL BWP**: Active DL bandwidth part as defined in TS 38.213 [3].

**Blackbox Approach:** Testing methodology, in which the UE internal implementation of certain specific UE functionality involved in the test, is unknown.

**Control Resource Set:** As defined in TS 38.213 [3].

**DL BWP**: DL bandwidth part as defined in TS 38.213 [3].

**EN-DC**: E-UTRA-NR Dual Connectivity as defined in clause 4.1.2 of TS 37.340 [17].

**en-gNB**: As defined in TS 37.340 [17].

**FR1**: Frequency range 1 as defined in clause 5.1 of TS 38.104 [13].

**FR2**: Frequency range 2 as defined in clause 5.1 of TS 38.104 [13].

**gNB**: as defined in TS 38.300 [10].

**LMF**: as defined in TS 38.305 [22].

**Master Cell Group:** As defined in TS 38.331 [2].

**Multi-Radio Dual Connectivity:** Dual Connectivity between E-UTRA and NR nodes, or between two NR nodes, as defined in TS 37.340 [17].

**ng-eNB**: As defined in TS 38.300 [10].

**NE-DC**: NR-E-UTRA Dual Connectivity as defined in clause 4.1.3.2 of TS 37.340 [17].

**NGEN-DC**: NG-RAN E-UTRA-NR Dual Connectivity as defined in clause 4.1.3.1 of TS 37.340 [17].

**NR-DC**: NR-NR Dual Connectivity as defined in clause 4.1.3.3 of TS 37.340 [17].

**Primary Cell**: As defined in TS 38.331 [2].

**PRS resource instance:** An instance in time of a configured PRS resource as defined in TS 38.331 [2], which may or not overlap with a measurement gap occasion.

**Quasi Co-Location:** As defined in TS 38.214 [26].

**RedCap UE: A UE with reduced capabilities as defined in clause 4.2 in TS 38.306 [14].**

**RLM-RS resource:** A resource out of the set of resources configured for RLM by higher layer parameter RLM-RS-List [2] as defined in TS 38.213 [3].

**SA operation mode**: Operation mode when the UE is configured with at least PCell and not any MR-DC.

**Secondary Cell**: As defined in TS 38.331 [2].

**Secondary Cell Group:** As defined in TS 38.331 [2].

**Serving Cell**: As defined in TS 38.331 [2].

**SMTC**: An SSB-based measurement timing configuration configured by *SSB-MeasurementTimingConfiguration* as specified in TS 38.331 [2].

**Special Cell:** As defined in TS 38.331 [2].

**SSB:** SS/PBCH block as defined in clause 7.8.3 of TS 38.211 [6].

**Timing Advance Group**: As defined in TS 38.331 [2].

**--- End of change 1 ---**

**--- Start of change 2 ---**

### 3.6.11 Applicability of requirements for Redcap UEs

### 3.6.11.1 RRC connected state requirements in DRX

The requirements in clause 3.6.1 shall apply.

### 3.6.11.2 Applicability for FR2 Redcap UE power classes

The requirements in clause 3.6.4 shall apply.

### 3.6.11.3 Applicability of QCL

The requirements in clause 3.6.7 shall apply.

**--- End of change 2 ---**

**--- Start of change 3 ---**

## 4.2B Cell Re-selection for RedCap

### 4.2B.1 Introduction

### 4.2B.2 Requirements

4.2B.2.1 UE measurement capability for RedCap

##### 4.2B.2.1.1 UE measurement capability for 1 Rx RedCap

For idle mode cell re-selection purposes, and for UE supporting *IdleInactiveMeasurements-r16* or *idleInactiveEUTRA-MeasReport-r16*, the UE shall be capable of monitoring at least:

- Intra-frequency carrier, and

- Depending on UE capability, 6 NR inter-frequency carriers, and

- Depending on UE capability, 6 FDD E-UTRA inter-RAT carriers, and

- Depending on UE capability, 6 TDD E-UTRA inter-RAT carriers.

In addition to the requirements defined above, a UE supporting E-UTRA measurements in RRC\_IDLE state shall be capable of monitoring a total of at least 11 carrier frequency layers, which includes serving layer, comprising of any above defined combination of E-UTRA FDD, E-UTRA TDD and NR layers.

##### 4.2B.2.1.2 UE measurement capability for 2 Rx RedCap

The capability defined in section 4.2.2.1 apply for this section.

4.2B.2.2 Measurement and evaluation of serving cell for RedCap UE

The UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every M1\*N1 DRX cycle; where:

M1=2 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second,

otherwise M1=1.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least DRX cycle/2.

If the UE is not configured with eDRX\_IDLE cycle and the UE has evaluated according to Table 4.2B.2.2-1 for 1 Rx RedCap or Table 4.2.2.2-1 for 2 Rx RedCap in Nserv\_RedCap consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

If the UE is configured with eDRX\_IDLE cycle and has evaluated according Nserv\_RedCap consecutive DRX cycles within a single PTW that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities. For the UE configured with eDRX\_IDLE cycle, Nserv\_RedCap is specified in Table 4.2B.2.2-2 for 1 Rx RedCap and 2 Rx RedCap in FR1 and in Table 4.2B.2.2-3 for FR2 for 2 Rx RedCap.

If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information during the time T, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1], where

* T= [10 s] if the UE is not configured with eDRX\_IDLE cycle, or
* T= MAX (10 s, one eDRX\_IDLE cycle) if the UE is configured with eDRX\_IDLE cycle in FR1, or
* T= MAX (10 s, K1\*N1\* eDRX\_IDLE cycle) if the UE is configured with eDRX\_IDLE cycle less than 20.48s in FR2, where:

K1 = [1]

* Otherwise, T= [MAX (10 s, one eDRX\_IDLE cycle)] if the UE is configured with eDRX\_IDLE cycle no less than 20.48s in FR2

*Editor’s Note: The value of T is being discussed and may need to be revised based on the agreement.*

Table 4.2B.2.2-1: Nserv\_RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Nserv\_RedCap [number of DRX cycles] |
|  | FR1 | FR2Note1 |  |
| 0.32 | 1 | 8 | M1\*N1\*4 |
| 0.64 |  | 5 | M1\*N1\*4 |
| 1.28 |  | 4 | N1\*2 |
| 2.56 |  | 3 | N1\*2 |
| Note 1: Applies for RedCap UE of all FR2 power class. | | | |

Table 4.2B.2.2-2: Nserv\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Scaling Factor (N1) | Nserv\_RedCap [number of DRX or eDRX cycles Note 3] |
| 2.56 | N/A | N/A | 1 | N1\*2 |
| 5.12 | N/A | N/A | N1\*2 |
| 10.24 | N/A | N/A | N1\*2 |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥[1.28] (1) | N1\*M1\*2 |
| 0.64 | ≥ 1.28 (1) (M1=1) or ≥ 2.56 (2) (M1=2) | N1\*M1\*2 |
| 1.28 | ≥2.56 (2) | N1\*2 |
| 2.56 | ≥5.12 (4) | N1\*2 |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 4: The lower bound of PTW length is derived based on . | | | | |

Table 4.2B.2.2-3: Nserv\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

*Editor Notes: The requirement of eDRX = 20.48s with DRX = 0.32s is FFS.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Scaling Factor (N1) Note1 | Nserv\_RedCap [number of DRX or eDRX cycles Note 3] |
| 2.56 | N/A | N/A | 3 | N1\*2 |
| 5.12 | N/A | N/A | 3 | N1\*2 |
| 10.24 | N/A | N/A | 3 | N1\*2 |
| [20.48] ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥5.12 (4) | 8 | N1\*2 |
| 0.64 | ≥6.4 (5) | 5 | N1\*2 |
| 1.28 | ≥10.24 (8) | 4 | N1\*2 |
| 2.56 | ≥15.36 (12) | 3 | N1\*2 |
| NOTE 1: Applies for RedCap UE of all FR2 power class.  NOTE 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 4: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 5: The lower bound of PTW length is derived based on . | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE has to meet the requirement corresponding to the second state.

4.2B.2.3 Measurements of intra-frequency NR cells for RedCap UE

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP and SS-RSRQ measurements of the identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 [1] within Tdetect,NR\_Intra\_RedCapwhen that Treselection= 0. An intra frequency cell is considered to be detectable according to the conditions defined in Annex B.x.y for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Tmeasure,NR\_Intra\_RedCap for intra-frequency cells that are identified and measured according to the measurement rules.

The UE shall filter SS-RSRP and SS-RSRQ measurements of each measured intra-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Intra\_RedCap/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined in TS38.304 [1] within Tevaluate,NR\_Intra\_RedCap when Treselection = 0 provided that:

when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2 for RedCap UE with 2 Rx RedCap.

- the cell is at least [3dB] better ranked in FR1 for 1 Rx RedCap.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in TS38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them.

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2 if the current serving cell is among them for 2 Rx RedCap.

- the cell is at least [3dB] better ranked in FR1 if the current serving cell is among them for 1 Rx RedCap.

When evaluating cells for reselection, the SSB side conditions apply to both serving and non-serving intra-frequency cells.

If Treselection timer has a non zero value and the intra-frequency cell is satisfied with the reselection criteria which are defined in TS38.304 [1], the UE shall evaluate this intra-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

For 1 Rx RedCap not configured with eDRX\_IDLE cycle, Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap are specified in Table 4.2B.2.3-1. For 2 Rx RedCap not configured with eDRX\_IDLE cycle, Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap are same as Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra specified in Table 4.2.2.3-1.

For 1 Rx RedCap and 2 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap are specified in Table 4.2B.2.3-2 and Table 4.2B.2.3-3 for FR1 and FR2 respectively, where the requirements apply provided that the serving cell is configured with eDRX\_IDLE and is the same in all PTWs during any of Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap when multiple PTWs are used.

Table 4.2B.2.3-1: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_RedCap  [s] (number of DRX cycles) |
|  | FR1 | FR2Note1 |  |  |  |
| 0.32 | 1 | 8 | 11.52 x N1 x M2 (36 x N1 x M2) | 1.28 x N1 x M2 (4 x N1 x M2) | 5.12 x N1 x M2 (16 x N1 x M2) |
| 0.64 |  | 5 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 |  | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 |  | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for RedCap UE of all FR2 power class.  Note 2: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected. | | | | | |

Table 4.2B.2.3-2: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_RedCap [s] (number of DRX cycles)** |
| 2.56 | - | - | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | - | - | 117.76 (23) | 5.12 (1) | 10.24 (2) |
| 10.24 | - | - | 235.52 (23) | 10.24 (1) | 20.48 (2) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥[1.28] ([1]) | (23) | 0.32 x M2 (1 x M2) | 0.64 x M2 (2 x M2) |
| 0.64 | ≥[1.28] ([1]) | 0.64 (1) | 1.28 (2) |
| 1.28 | ≥[2.56] ([2]) | 1.28 (1) | 2.56 (2) |
| 2.56 | ≥[5.12] ([4]) | 2.56 (1) | 5.12 (2) |
| Note 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  Note 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  Note 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  Note 4: The lower bound of PTW length is derived based on . | | | | | |

Table 4.2B.2.3-3: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Scaling Factor (N1)** Note1 | **Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_RedCap [s] (number of DRX cycles)** |
| 2.56 | - | - | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| 5.12 | - | - | 3 | 117.76 x N1 (23 x N1) | 5.12 x N1 (1 x N1) | 10.24 x N1 (2 x N1) |
| 10.24 | - | - | 3 | 235.52 x N1 (23 x N1) | 10.24 x N1 (1 x N1) | 20.48 x N1 (2 x N1) |
| [20.48] ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥5.12 (4) | 8 | (23 x N1) | 0.32 x N1 (1 x N1) | 0.64 x N1 (2 x N1) |
| 0.64 | ≥6.4 (5) | 5 | 0.64 x N1 (1 x N1) | 1.28 x N1 (2 x N1) |
| 1.28 | ≥10.24 (8) | 4 | 1.28 x N1 (1 x N1) | 2.56 x N1 (2 x N1) |
| 2.56 | ≥15.36 (12) | 3 | 2.56 x N1 (1 x N1) | 5.12 x N1 (2 x N1) |
| NOTE 1: Applies for RedCap UE of all power class.  NOTE 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 4: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 5: The lower bound of PTW length is derived based on . | | | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE has to meet the requirement corresponding to the second state.

4.2B.2.4 Measurements of inter-frequency NR cells for RedCap UE

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP or SS-RSRQ measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority layers shall be the same as that defined below in this clause.

The UE shall be able to evaluate whether a newly detectable inter-frequency cell meets the reselection criteria defined in TS38.304 [1] within Kcarrier\_RedCap \* Tdetect,NR\_Inter\_RedCap if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when Treselection = 0 provided that the reselection criteria is met by a margin of at least 5 dB in FR1 or 6.5 dB in FR2 for reselections based on ranking or 6 dB in FR1 or 7.5 dB in FR2 for SS-RSRP reselections based on absolute priorities or 4 dB in FR1 and 4 dB in FR2 for SS-RSRQ reselections based on absolute priorities for 2 Rx RedCap and at least [5 dB] in FR1 or for reselections based on ranking or [6 dB] in FR1 for SS-RSRP reselections based on absolute priorities or [4 dB] in FR1 for SS-RSRQ reselections based on absolute priorities for 1 Rx RedCap. The parameter Kcarrier\_RedCap is the number of NR inter-frequency carriers indicated by the serving cell. An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B.x.y for a corresponding Band.When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,NR\_Inter\_RedCap. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall measure SS-RSRP or SS-RSRQ at least every Kcarrier\_RedCap \* Tmeasure,NR\_Inter\_RedCap for identified lower or equal priority inter-frequency cells. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall filter SS-RSRP or SS-RSRQ measurements of each measured higher, lower and equal priority inter-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Inter/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an inter-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 38.304 [1] within Kcarrier \* Tevaluate,NR\_Inter\_RedCap when Treselection = 0provided that the reselection criteria is met by

- the condition when performing equal priority reselection and

when *rangeToBestCell* is not configured:

- the cell is at least 5dB better ranked in FR1 or 6.5dB better ranked in FR2 for 2 Rx RedCap.

- the cell is at least [5dB] better ranked in FR1 for 1 Rx RedCap.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in TS38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them

- the cell is at least 5dB better ranked in FR1 or 6.5dB better ranked in FR2 if the current serving cell is among them, or 6dB in FR1 or 7.5dB in FR2 for SS-RSRP reselections based on absolute priorities for 2 Rx RedCap or 4dB in FR1 or 4dB in FR2 for SS-RSRQ reselections based on absolute priorities for 2 Rx RedCap.

- the cell is at least [5dB] better ranked in FR1 if the current serving cell is among them, or [6dB] in FR1 for SS-RSRP reselections based on absolute priorities or [4dB] in FR1 for SS-RSRQ reselections based on absolute priorities for 1 Rx RedCap.

When evaluating cells for reselection, the SSB side conditions apply to both serving and inter-frequency cells.

If Treselection timer has a non zero value and the inter-frequency cell is satisfied with the reselection criteria, the UE shall evaluate this inter-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

The UE is not expected to meet the measurement requirements for an inter-frequency carrier under DRX cycle=320 ms defined in Table 4.2B.2.4-1 or Table 4.2.2.4-1 for 1 Rx RedCap and 2 Rx RedCap respectively, under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where TSMTC\_intra and TSMTC\_inter are periodicities of the SMTC occasions configured for the intra-frequency carrier and the inter-frequency carrier respectively, and

- SMTC occasions configured for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the SMTC occasions configured for the intra-frequency carrier, and

- SMTC occasions configured for the intra-frequency carrier and for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the paging occasion in TS38.304 [1].

For UE not configured with eDRX\_IDLE cycle, Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap are specified in Table 4.2B.2.4.1-1.

For 1 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,NR\_ Inter \_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap are specified in Table 4.2B.2.4-2 for FR1. For 1 Rx RedCap UE and 2 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,NR\_ Inter \_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap are specified in Table 4.2B.2.4-2 and Table 4.2B.2.4-3 for FR1 and FR2 respectively. The requirements apply provided that the serving cell is configured with eDRX\_IDLE and is the same in all PTWs during any of Tdetect,NR\_ Inter \_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap when multiple PTWs are used.

Table 4.2B.2.4-1: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_RedCap [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_RedCap [s] (number of DRX cycles) |
| FR1 | FR2Note1 |
| 0.32 | 1 | 8 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 | 5 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for RedCap UE of all FR2 power class. | | | | | |

Table 4.2B.2.4-2: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter\_RedCap** **[s] (number of DRX cycles)** | **Tevaluate,NR\_Inter\_RedCap****[s] (number of DRX cycles)** |
|
| 2.56 | - | - | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | - | - | 117.76 (23) | 5.12 (1) | 10.24 (2) |
| 10.24 | - | - | 235.52 (23) | 10.24 (1) | 20.48 (2) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥1.28 (1) | (23) | 0.32 x 1.5 (1 x 1.5) | 0.64 x 1.5 (2 x 1.5) |
| 0.64 | ≥1.28 (1) | 0.64 (1) | 1.28 (2) |
| 1.28 | ≥2.56 (2) | 1.28 (1) | 2.56 (2) |
| 2.56 | ≥5.12 (4) | 2.56 (1) | 5.12 (2) |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 4: The lower bound of PTW length is derived based on . | | | | | |

Table 4.2B.2.4-3: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Scaling Factor (N1)** Note1 | **Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter\_RedCap** **[s] (number of DRX cycles)** | | **Tevaluate,NR\_Inter\_RedCap****[s] (number of DRX cycles)** |
| 2.56 | - | - | 3 | 58.88 x N1 (23 x N1) | | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| 5.12 | - | - | 3 | 117.76 x N1 (23 x N1) | | 5.12 x N1 (1 x N1) | 10.24 x N1 (2 x N1) |
| 10.24 | - | - | 3 | 235.52 x N1 (23 x N1) | | 10.24 x N1 (1 x N1) | 20.48 x N1 (2 x N1) |
| [20.48] ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥5.12 (4) | 8 | (23 x N1) | | 0.32 x N1 (1 x N1) | 0.64 x N1 (2 x N1) |
| 0.64 | ≥6.4 (5) | 5 | 0.64 x N1 (1 x N1) | 1.28 x N1 (2 x N1) |
| 1.28 | ≥10.24 (8) | 4 | 1.28 x N1 (1 x N1) | 2.56 x N1 (2 x N1) |
| 2.56 | ≥15.36 (12) | 3 | 2.56 x N1 (1 x N1) | 5.12 x N1 (2 x N1) |
| NOTE 1: Applies for RedCap UE of all power class.  NOTE 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 4: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 5: The lower bound of PTW length is derived based on . | | | | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE has to meet the requirement corresponding to the second state.

4.2B.2.5 Measurements of inter-RAT E-UTRAN cells for RedCap UE

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-RAT E-UTRAN layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2B.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-RAT E-UTRAN layers of higher, lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority inter-RAT E-UTRAN layers shall be the same as that defined below for lower priority RATs.

The requirements in this clause apply for inter-RAT E-UTRAN FDD measurements and E-UTRA TDD measurements. When the measurement rules indicate that inter-RAT E-UTRAN cells are to be measured, the UE shall measure RSRP and RSRQ of detected E-UTRA cells in the neighbour frequency list at the minimum measurement rate specified in this clause.

The parameter NEUTRA\_carrier\_RedCap is the total number of configured E-UTRA carriers in the neighbour frequency list. The UE shall filter RSRP and RSRQ measurements of each measured E-UTRA cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,EUTRAN\_RedCap/2.

An inter-RAT E-UTRA cell is considered to be detectable provided the following conditions are fulfilled:

- the same conditions as for inter-frequency RSRP measurements specified in TS 36.133 [15, Annex B.x.y] are fulfilled for a corresponding Band, and

- the same conditions as for inter-frequency RSRQ measurements specified in TS 36.133 [15, Annex B.x.y] are fulfilled for a corresponding Band.

- SCH conditions specified in TS 36.133 [15, Annex B.x.y] are fulfilled for a corresponding Band

The UE shall be able to evaluate whether a newly detectable inter-RAT E-UTRAN cell meets the reselection criteria defined in TS38.304 [1] within (NEUTRA\_carrier\_RedCap) \* Tdetect,EUTRAN\_RedCap when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ when Treselection = 0 provided that the reselection criteria is met by a margin of at least 6dB for RSRP reselections based on absolute priorities or 4dB for RSRQ reselections based on absolute priorities for 2 Rx RedCap and at least [6dB] for RSRP reselections based on absolute priorities or [4dB] for RSRQ reselections based on absolute priorities for 1 Rx RedCap.

Cells which have been detected shall be measured at least every (NEUTRA\_carrier\_RedCap) \* Tmeasure,EUTRAN\_RedCap when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,EUTRAN\_RedCap. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell.

If the UE detects on an inter-RAT E-UTRAN carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall not consider an inter-RAT E-UTRA cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For a cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that an already identified inter-RAT E-UTRA cell has met reselection criterion defined in TS 38.304 [1] within (NEUTRA\_carrier\_RedCap) \* Tevaluate,EUTRAN\_RedCap when Treselection = 0provided that the reselection criteria is met by a margin of at least 6dB for RSRP reselections based on absolute priorities or 4dB for RSRQ reselections based on absolute priorities for 2 Rx RedCap and at least [6dB] for RSRP reselections based on absolute priorities or [4dB] for RSRQ reselections based on absolute priorities for 1 Rx RedCap.

If Treselection timer has a non zero value and the inter-RAT E-UTRA cell is satisfied with the reselection criteria which are defined in TS 38.304 [1], the UE shall evaluate this E-UTRA cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

For 1 Rx RedCap and 2 Rx RedCap not configured with eDRX\_IDLE cycle, Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap and Tevaluate, E-UTRAN\_RedCap are specified in Table 4.2B.2.5-1 and Table 4.2.2.5-1 respectively.

For 1 Rx RedCap and 2 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap and Tevaluate, E-UTRAN\_RedCap are specified in Table 4.2B.2.5-2, where the requirements apply provided that the serving cell is configured with eDRX\_IDLE and is the same in all PTWs during any of Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap and Tevaluate, E-UTRAN\_RedCap when multiple PTWs are used.

Table 4.2B.2.5-1: Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap, and Tevaluate,EUTRAN\_RedCap for 1 Rx RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN [s] (number of DRX cycles) | Tmeasure,EUTRAN [s] (number of DRX cycles) | Tevaluate,EUTRAN  [s] (number of DRX cycles) |
| 0.32 | 11.52 (36) | 1.28 (4) | 5.12 (16) |
| 0.64 | 17.92 (28) | 1.28 (2) | 5.12 (8) |
| 1.28 | 32(25) | 1.28 (1) | 6.4 (5) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |

Table 4.2B.2.5-2: Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap, and Tevaluate,EUTRAN\_RedCap for UE configured with eDRX\_IDLE cycle

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Tdetect,EUTRAN\_RedCap [s] (number of DRX or eDRX cycles Note 3) | Tmeasure,EUTRAN\_RedCap [s] (number of DRX or eDRX cycles Note 3) | Tevaluate,E-UTRAN\_RedCap  [s] (number of DRX or eDRX cycles Note 3) |
| 5.12 | N/A | N/A | 117.76 (23) | 5.12 (1) | 10.24 (2) |
| 10.24 ≤ eDRX\_IDLE cycle length ≤ 2621.444 | 0.32 | ≥1.28 (1) | (23) | 0.32 (1) | 0.64 (2) |
| 0.64 | ≥1.28 (1) | 0.64 (1) | 1.28 (2) |
| 1.28 | ≥2.56 (2) | 1.28 (1) | 2.56 (2) |
| 2.56 | ≥5.12 (4) | 2.56 (1) | 5.12 (2) |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 5.12s, number of DRX cycles otherwise.  NOTE 4: The lower bound of PTW length is derived based on . | | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE has to meet the requirement corresponding to the second state.

4.2B.2.6 Maximum interruption in paging reception for RedCap

[The FDD, HD-FDD and TDD RedCap UE shall meet all applicable requirements specified in clause 4.2.2.6]. In addition, when the UE is configured with eDRX\_IDLE cycle, the UE shall not miss any paging in a PTW provided the paging is sent in at least 2 DRX cycles before the end of that PTW.

The 1 Rx RedCap in HD-FDD shall meet all applicable requirements specified in clause 4.2.2.6 under the following conditions

- at least 1 SSB is available at the UE in the serving cell during the last 160 ms duration.

4.2B.2.7  General requirements for RedCap

The requirements defined in section 4.2.2.7 apply for this section.

**--- End of change 3 ---**

**--- Start of change 4 ---**

4.2B.2.8     Minimum requirement at transitions

When switching from:

* low mobility scenario to stationary scenario, or
* from low mobility scenario to stationary and not-at-cell-edge scenario,

the UE shall fulfill the requirements corresponding to low mobility scenario over measurement period (Trelaxed) and thereafter switch to requirements corresponding to stationary scenario, or stationary and not-at-cell-edge scenario. The measurement period, Trelaxed, is any of:

- Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax, defined in section 4.2B.2.9 for intra-frequency measurements on NR cells,

- Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax defined in section 4.2B.2.10 for inter-frequency measurements on NR cells and

- Tmeasure,EUTRAN\_RedCap\_Relax and Tevaluate,EUTRAN\_RedCap\_Relax defined in sections 4.2B.2.11 for inter-RAT E-UTRAN measurements.

When switching from:

* stationary scenario to low mobility scenario, or
* stationary and not-at-cell-edge scenario to low mobility scenario,

the UE shall fulfill the requirements corresponding to low mobility scenario upon fulfilling the switching criteria.

When switching from normal mode to low mobility scenario, stationary scenario or stationary and not-at-cell edge scenario during cell-reselection period, the UE shall fulfill the requirements corresponding to normal mode over measurement period (Tnormal) and thereafter switch to requirements corresponding to low mobility scenario, stationary scenario or stationary and not-at-cell edge scenario. The measurement period, Tnormal, is any of:

- Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap, defined in section 4.2B.2.3 for intra-frequency measurements on NR cells,

- Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap defined in section 4.2B.2.4 for inter-frequency measurements on NR cells and

- Tmeasure,EUTRAN\_RedCap and Tevaluate,EUTRAN\_RedCap defined in sections 4.2B.2.5 for inter-RAT E-UTRAN measurements.

When switching from:

* low mobility scenario to normal mode, or
* stationary scenario to normal mode, or
* stationary and not-at-cell-edge scenario to normal mode

the UE shall fulfill the requirements corresponding to normal mode upon fulfilling the switching criteria.

No requirement is defined for multiple transitions of scenarios within one measurement period.

4.2B.2.9 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion for RedCap

##### 4.2B.2.9.1 Introduction

This clause contains the requirements for measurements on intra-frequency NR cells when Srxlev ≤ SIntraSearchP or Squal ≤ SIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for a stationary UE defined in clause 5.2.4.9.X in [1],

- Relaxed measurement criterion for a stationary UE not at cell edge defined in clause 5.2.4.9.Y in [1],

- Both low mobility criterion and stationary criterion as defined in clause 5.2.4.9.1 and 5.2.4.9.X in [1] respectively.

##### 4.2B.2.9.2 Measurements for UE fulfilling stationary criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and UE has fulfilled that criterion, or

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled only the *stationaryMobilityEvaluation* [2] criterion

The requirements defined in clause 4.2B.2.3 apply for this clause except that:

- Tdetect,NR\_Intra\_RedCap\_Relaxas specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,NR\_Intra\_RedCap\_Relax as specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,NR\_Intra\_RedCap\_Relax as specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.9.2-3 and Table 4.2B.2.9.2-4 are applicable for eDRX cycle up to 10.24 s in FR1 and FR2 respectively.

*Editors note: For eDRX cycle larger than 10.24 s the requirements will be updated based on the agreement.*

Table 4.2B.2.9.2-1: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UEs fulfilling stationary criterion for 1 Rx RedCap UE

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_RedCap\_Relax  [s] (number of DRX cycles) |
|  |  |  |  |
| 0.32 | TBD x M2 x K3 (TBD x M2 x K3) | TBD x M2 x K3 (TBD x M2 x K3) | TBD x M2 x K3 (TBD x M2 x K3) |
| 0.64 | TBD x K3 (TBD x K3) | TBD x K3 (TBD x K3) | TBD x K3 (TBD x K3) |
| 1.28 | TBD x K3 (TBD x K3) | TBD x K3 (TBD x K3) | TBD x K3 (TBD x K3) |
| 2.56 | TBD x K3 (TBD x K3) | TBD x K3 (TBD x K3) | TBD x K3 (TBD x K3) |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.9.2-2: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UEs fulfilling stationary criterion for 2 Rx RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_RedCap\_Relax  [s] (number of DRX cycles) |
|  | FR1 | FR2Note1 |  |  |  |
| 0.32 | 1 | 8 | 11.52 x N1 x M2 x K3 (36 x N1 x M2 x K3) | 1.28 x N1 x M2 x K3 (4 x N1 x M2 x K3) | 5.12 x N1 x M2 x K3 (16 x N1 x M2 x K3) |
| 0.64 |  | 5 | 17.92 x N1 x K3 (28 x N1 x K3) | 1.28 x N1 x K3 (2 x N1 x K3) | 5.12 x N1 x K3 (8 x N1 x K3) |
| 1.28 |  | 4 | 32 x N1 x K3 (25 x N1 x K3) | 1.28 x N1 x K3 (1 x N1 x K3) | 6.4 x N1 x K3 (5 x N1 x K3) |
| 2.56 |  | 3 | 58.88 x N1 x K3 (23 x N1 x K3) | 2.56 x N1 x K3 (1 x N1 x K3) | 7.68 x N1 x K3 (3 x N1 x K3) |
| Note 1: Applies for RedCap UE of all supporting FR2 power class.  Note 2: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 3: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | | | |

Table 4.2B.2.9.2-3: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_RedCap [s] (number of DRX cycles)** |
|
| 2.56 | 58.88 x K3 (23 x K3) | 2.56 x K3 (1 x K3) | 7.68 x K3 (3 x K3) |
| 5.12 | 117.76 x K3 (23 x K3) | 5.12 x K3 (1 x K3) | 10.24 x K3 (2 x K3) |
| 10.24 | 235.52 x K3 (23 x K3) | 10.24 x K3 (1 x K3) | 20.48 x K3 (2 x K3) |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.9.2-4: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_RedCap [s] (number of DRX cycles)** |
|
| 2.56 | 58.88 x N1 x K3 (23 x N1 x K3) | 2.56 x N1 x K3 (1 x K3) | 7.68 x N1 x K3 (3 x N1 x K3) |
| 5.12 | 117.76 x N1 x K3 (23 x N1 x K3) | 5.12 x N1 x K3 (1 x N1 x K3) | 10.24 x N1 x K3 (2 x N1 x K3) |
| 10.24 | 235.52 x N1 x K3 (23 x N1 x K3) | 10.24 x N1 x K3 (1 x N1 x K3) | 20.48 x N1 x K3 (2 x N1 x K3) |
| Note 1: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the stationaryMobilityEvaluation [2] criterion. | | | |

##### 4.2B.2.9.3 Measurements for a UE fulfilling stationary not at cell edge criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and

- has also fulfilled both criteria, and

- less than TBD hours have passed since measurements for cell reselection were last performed

In this case the UE is not required to meet Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap as defined in clause 4.2B.2.3X.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.9.4 Measurements for a UE fulfilling low mobility and stationary criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *stationaryMobilityEvaluation* [2] criterion, and has also fulfilled both criteria, or,

- UE is configured with *lowMobilityEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *lowMobilityEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.9.2 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.9.5 Measurements for a UE fulfilling low mobility and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.9.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.9.6 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with cellEdgeEvaluation [2] criterion and UE has fulfilled that criterion, and
* UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.9.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.9.7 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and
* UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.9.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

4.2B.2.10 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

##### 4.2B.2.10.1 Introduction

This clause contains the requirements for measurements on intra-frequency NR cells when Srxlev ≤ SIntraSearchP or Squal ≤ SIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for a stationary UE defined in clause 5.2.4.9.X in [1],

- Relaxed measurement criterion for a stationary UE not at cell edge defined in clause 5.2.4.9.Y in [1],

- Both low mobility criterion and stationary criterion as defined in clause 5.2.4.9.1 and 5.2.4.9.X in [1] respectively.

##### 4.2B.2.10.2 Measurements for UE fulfilling stationary criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and UE has fulfilled that criterion, or

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled only the *stationaryMobilityEvaluation* [2] criterion, and

The requirements defined in clause 4.2B.2.4 apply for this clause except that:

- Tdetect,NR\_Inter\_RedCap\_Relaxas specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-1 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,NR\_Inter\_RedCap\_Relax as specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-1 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,NR\_Inter\_RedCap\_Relax as specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-1 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.10.2-3 and Table 4.2B.2.10.2-4 are applicable for eDRX cycle up to 10.24 s in FR1 and FR2 respectively.

*Editors note: For eDRX cycle larger than 10.24 s the requirements will be updated based on the agreement.*

Table 4.2B.2.10.2-1: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax for 1 Rx RedCap UE

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles) |
| 0.32 | TBD x 1.5 x K4(TBD x 1.5 x K4) | TBD x 1.5 x K4 (TBD x 1.5 x K4) | TBD x 1.5 x K4 (TBD x 1.5 x K4) |
| 0.64 | TBD x K4 (TBD x K4) | TBD x K4 (TBD x K4) | TBD x K4 (TBD x K4) |
| 1.28 | TBD x K4 (TBD x K4) | TBD x K4 (TBD x K4) | TBD x K4 (TBD x K4) |
| 2.56 | TBD x K4 (TBD x K4) | TBD x K4 (TBD x K4) | TBD x K4 (TBD x K4) |
| Note 1: K4 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.10.2-2: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax for 2 Rx RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Inter [s] (number of DRX cycles) | Tmeasure,NR\_Inter [s] (number of DRX cycles) | Tevaluate,NR\_Inter [s] (number of DRX cycles) |
| FR1 | FR2Note1 |
| 0.32 | 1 | 8 | 11.52 x N1 x 1.5 x K4 (36 x N1 x 1.5 x K4) | 1.28 x N1 x 1.5 x K4 (4 x N1 x 1.5 x K4) | 5.12 x N1 x 1.5 x K4 (16 x N1 x 1.5 x K4) |
| 0.64 |  | 5 | 17.92x N1 x K4 (28 x N1 x K4) | 1.28 x N1 x K4 (2 x N1 x K4) | 5.12 x N1 x K4 (8 x N1 x K4) |
| 1.28 |  | 4 | 32 x N1 x K4 (25 x N1 x K4) | 1.28 x N1 x K4 (1 x N1 x K4) | 6.4 x N1 x K4 (5 x N1 x K4) |
| 2.56 |  | 3 | 58.88 x N1 x K4 (23 x N1 x K4) | 2.56 x N1 x K4 (1 x N1 x K4) | 7.68 x N1 x K4 (3 x N1 x K4) |
| Note 1: Applies for RedCap UE of all supporting power class.  Note 2: K4 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | | | |

Table 4.2B.2.10.2-3: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter\_RedCap [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter\_RedCap [s] (number of DRX cycles)** |
|
| 2.56 | 58.88 x K3 (23 x K3) | 2.56 x K3 (1 x K3) | 7.68 x K3 (3 x K3) |
| 5.12 | 117.76 x K3 (23 x K3) | 5.12 x K3 (1 x K3) | 10.24 x K3 (2 x K3) |
| 10.24 | 235.52 x K3 (23 x K3) | 10.24 x K3 (1 x K3) | 20.48 x K3 (2 x K3) |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.10.2-4: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter\_RedCap [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter\_RedCap [s] (number of DRX cycles)** |
|
| 2.56 | 58.88 x N1 x K3 (23 x N1 x K3) | 2.56 x N1 x K3 (1 x K3) | 7.68 x N1 x K3 (3 x N1 x K3) |
| 5.12 | 117.76 x N1 x K3 (23 x N1 x K3) | 5.12 x N1 x K3 (1 x N1 x K3) | 10.24 x N1 x K3 (2 x N1 x K3) |
| 10.24 | 235.52 x N1 x K3 (23 x N1 x K3) | 10.24 x N1 x K3 (1 x N1 x K3) | 20.48 x N1 x K3 (2 x N1 x K3) |
| Note 1: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the stationaryMobilityEvaluation [2] criterion. | | | |

##### 4.2B.2.10.3 Measurements for a UE fulfilling stationary not at cell edge criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and

- has also fulfilled both criteria, and

- less than TBD hours have passed since measurements for cell reselection were last performed, and

In this case the UE is not required to meet Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap as defined in clause 4.2B.2.4.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.10.4 Measurements for a UE fulfilling low mobility and stationary criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *stationaryMobilityEvaluation* [2] criterion, and has also fulfilled both criteria, or,

- UE is configured with *lowMobilityEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *lowMobilityEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.10.2 apply for this clause.

*Editor’s note: The requirements shall be updated when agreement is reached.*

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.10.5 Measurements for a UE fulfilling low mobility and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.10.3 apply for this clause.

*Editor’s note: The requirements shall be updated when agreement is reached.*

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.10.6 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with cellEdgeEvaluation [2] criterion and UE has fulfilled that criterion, and
* UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.10.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.10.7 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and
* UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.10.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

4.2B.2.11 Measurements of inter-RAT E-UTRAN cells for UE configured with relaxed measurement criterion

##### 4.2B.2.11.1 Introduction

This clause contains the requirements for measurements on intra-frequency NR cells when Srxlev ≤ SIntraSearchP or Squal ≤ SIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for a stationary UE defined in clause 5.2.4.9.X in [1],

- Relaxed measurement criterion for a stationary UE not at cell edge defined in clause 5.2.4.9.Y in [1],

- Both low mobility criterion and stationary criterion as defined in clause 5.2.4.9.1 and 5.2.4.9.X in [1] respectively.

##### 4.2B.2.11.2 Measurements for UE fulfilling stationary criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and UE has fulfilled that criterion, or

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled only the *stationaryMobilityEvaluation* [2] criterion, and

The requirements defined in clause 4.2B.2.5 apply for this clause except that:

- Tdetect,EUTRAN\_Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,EUTRAN\_Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,EUTRAN\_Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

Table 4.2B.2.11.2-1: Tdetect,EUTRAN\_RedCap\_Relax, Tmeasure,EUTRAN\_RedCap\_Relax, and Tevaluate,EUTRAN\_RedCap\_Relax for 1 Rx RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN\_Relax [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Relax [s] (number of DRX cycles) | Tevaluate,EUTRAN\_Relax  [s] (number of DRX cycles) |
| 0.32 | 11.52 x K5 (36 x K5) | 1.28 x K5 (4 x K5) | 5.12 x K5 (16 x K5) |
| 0.64 | 17.92 x K5 (28 x K5) | 1.28 x K5 (2 x K5) | 5.12 x K5 (8 x K5) |
| 1.28 | 32 x K5 (25 x K5) | 1.28 x K5 (1 x K5) | 6.4 x K5 (5 x K5) |
| 2.56 | 58.88 x K5 (23 x K5) | 2.56 x K5 (1 x K5) | 7.68 x K5 (3 x K5) |
| Note 1: K5 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.11.2-2: Tdetect,EUTRAN, Tmeasure,EUTRAN, and Tevaluate,EUTRAN for 2 Rx RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN [s] (number of DRX cycles) | Tmeasure,EUTRAN [s] (number of DRX cycles) | Tevaluate,EUTRAN  [s] (number of DRX cycles) |
| 0.32 | 11.52 x K5 (36 x K5) | 1.28 x K5 (4 x K5) | 5.12 x K5 (16 x K5) |
| 0.64 | 17.92 x K5 (28 x K5) | 1.28 x K5 (2 x K5) | 5.12 x K5 (8 x K5) |
| 1.28 | 32 x K5 (25 x K5) | 1.28 x K5 (1 x K5) | 6.4 x K5 (5 x K5) |
| 2.56 | 58.88 x K5 (23 x K5) | 2.56 x K5 (1 x K5) | 7.68 x K5 (3 x K5) |

##### 4.2B.2.11.3 Measurements for a UE fulfilling stationary not at cell edge criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and

- has also fulfilled both criteria, and

- less than TBD hours have passed since measurements for cell reselection were last performed, and

In this case the UE is not required to meet Tdetect,EUTRAN, Tmeasure,EUTRAN and Tevaluate,EUTRAN as defined in clause 4.2B.2.5.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.11.4 Measurements for a UE fulfilling low mobility and stationary criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *stationaryMobilityEvaluation* [2] criterion, and has also fulfilled both criteria, or,

- UE is configured with *lowMobilityEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *lowMobilityEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.11.2 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.11.5 Measurements for a UE fulfilling low mobility and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.11.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.11.6 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with cellEdgeEvaluation [2] criterion and UE has fulfilled that criterion, and
* UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.11.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

##### 4.2B.2.11.7 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and
* UE is configured with *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.11.3 apply for this clause.

*Editor’s Note: FFS: Requirements for power saving when the UE is configured for eDRX can be added based on the agreement.*

**--- End of change 4 ---**

**--- Start of change 5 ---**

*Big CR Editor’s Note: Placeholder for adding following changes:*

*- Measurement and evaluation of serving cell of RedCap UE in INACTIVE mode*

*- Measurements of intra-frequency NR cells of RedCap UE in INACTIVE mode*

*- Measurements of inter-frequency NR cells of RedCap UE in INACTIVE mode*

*Editor’s Note: RedCap requirements in RRC INACTIVE state.*

## 5.1B Cell Re-selection for RedCap

### 5.1B.1 Introduction

### 5.1B.2 Requirements

5.1B.2.1 UE measurement capability

The requirements in clause 4.2B.2.1 shall apply.

5.1B.2.2 Measurement and evaluation of serving cell

5.1B.2.3 Measurements of intra-frequency NR cells

5.1B.2.4 Measurements of inter-frequency NR cells

5.1B.2.5 Measurements of inter-RAT E-UTRAN cells

The requirements in clause 4.2B.2.5 shall apply.

#### 5.1B.2.6 Maximum interruption in paging reception

The requirements in clause 4.2B.2.6 shall apply for RedCap UEs.

For RedCap UE in HD-FDD mode, if a paging occasion overlaps with CG-SDT transmission then the UE shall monitor the paging during the paging occasion. In this case the UE is allowed to drop the CG-SDT transmission.

**--- End of change 5 ---**

**--- Start of change 6 ---**

5.1B.2.7  General requirements

The requirements in sub-clause 4.2B.2.7 shall apply.

5.1B.2.8     Minimum requirement at transitions

The requirements in sub-clause 4.2B.2.8 shall apply.

5.1B.2.9 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2B.2.9 apply for UE configured with relaxed measurement criterion.

5.1B.2.10 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2B.2.10 apply for UE configured with relaxed measurement criterion.

5.1B.2.11 Measurements of inter-RAT E-UTRAN cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2B.2.11 apply for UE configured with relaxed measurement criterion.

**--- End of change 6 ---**

**--- Start of change 7 ---**

5.1B.2.12  Small Data Transmission requirements for RedCap

*Editor’s Note: SDT requirements for RedCap will be defined in this section.*

This section contains the requirements for Small Data Transmissions (SDT) for RedCap UEs.

##### 5.1B.2.12.1 SDT requirements for 1 Rx RedCap

*Editor’s Note: SDT requirements for RedCap will be defined in this section.*

##### 5.1B.2.12.2 SDT requirements for 2 Rx RedCap

*Editor’s Note: SDT requirements for RedCap will be defined in this section.*

**--- End of change 7 ---**

**--- Start of change 8 ---**

## 6.1C Handover for RedCap

### 6.1C.1 NR Handover

#### 6.1C.1.1 Introduction

The purpose of NR handover is to change the NR PCell to another NR cell for RedCap UE. The requirements in this clause are applicable to SA NR.

#### 6.1C.1.2 NR FR1 - NR FR1 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR1 cell to NR FR1 cell. The requirements in clause 6.1.1.2 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements defined in clause 6.1.1.2 shall apply except that:

- Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = [TBD]\*Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = [TBD]\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

#### 6.1C.1.3 NR FR2- NR FR2 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR1 cell to NR FR1 cell. The requirements in clause 6.1.1.4 shall apply when RedCap UE is capable of 2 Rx.

### 6.1C.2 NR Handover to other RATs

#### 6.1C.2.1 NR – E-UTRAN Handover

The purpose of inter-RAT handover from NR to E-UTRAN is to change the radio access mode of PCell from NR to E-UTRAN for RedCap UE. The handover procedure is initiated from NR with a RRC message that implies a handover as described in TS 38.331 [2]. The requirements in this clause are applicable to SA NR.

The requirements in clause 6.1.2.1 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements for category 1bis UE defined in clause 5.1.2 IN [15] shall apply.

**--- End of change 8 ---**

**--- Start of change 9 ---**

### 6.2.1B SA: RRC Re-establishment for RedCap

#### 6.2.1B.1 Introduction

This clause contains requirements on the RedCap UE regarding RRC connection re-establishment procedure.

#### 6.2.1B.2 Requirements

The requirements in clause 6.2.1 shall apply when RecCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements defined in clause 6.2.1 shall apply except that:

- Tidentify\_intra\_NRas specified in Table 6.2.1B.2-1.

- Tidentify\_inter\_NR, i as specified in Table 6.2.1B.2-2.

Table 6.2.1B.2-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell | FR of target NR | Tidentify\_intra\_NR [ms] | |
| SSB Ês/Iot (dB) | cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 6 x TSMTC) | MAX (800 ms, [11] x TSMTC) |
| < -8 | FR1 | N/A | 800Note1 |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

Table 6.2.1B.2-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | FR of target NR cell | Tidentify\_inter\_NR, i [ms] | |
|  |  | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 7 x TSMTC, i) | MAX (800 ms, [14] x TSMTC, i) |
| < -8 | FR1 | N/A | 800Note1 |
| Note 1: The UE is not required to successfully identify a cell on any NR frequency layer when TSMTC,i > 20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

**--- End of change 9 ---**

**--- Start of change 10 ---**

### 6.2.2B Random access for RedCap

#### 6.2.2B.1 Introduction

This clause contains requirements on the RedCap UE regarding random access procedure. The random access procedure is initiated to establish uplink time synchronization for a UE which either has not acquired or has lost its uplink synchronization, or to convey UE’s request Other SI, or for beam failure recovery. The random access is specified in clause 8 of TS 38.213 [3] and the control of the RACH transmission is specified in clause 5.1 of TS 38.321 [7]. Two types of procedure are defined for the random access, the 4-step RA type, and the 2-step RA type [7]. The decision on which type of procedure to adopt is as described in clause 5.1.1 of TS 38.321 [7].

#### 6.2.2B.2 Requirements

The requirements for the 4-step RA type procedure described in clause 6.2.2.2 and the requirements for the 2-step RA type procedure described in the clause 6.2.2.3 are applicable for TDD and TDD RedCap UEs. The 4-step and 2-step RA requirements for contention based random access defined in clause 6.2.2.2 and 6.2.2.3 respectively apply to HD-FD UE with the following conditions:

* The RedCap UE operating in HD-FDD mode is not expected to perform PRACH transmission on a PRACH resource of a cell if UE has not received at least one SSB associated with that PRACH resource during the last Tp period in the cell, where Tp=160 ms.
* The RedCap UE operating in HD-FDD mode shall meet the PRACH requirements when performing PRACH transmission on a PRACH resource of a cell provided that the UE has received at least one SSB associated with that PRACH resource during the last Tp period before the PRACH transmission, where Tp=160 ms.

**--- End of change 10 ---**

**--- Start of change 11 ---**

### 6.2.3A SA: RRC Connection Release with Redirection for RedCap

#### 6.2.3A.1 Introduction

This clause contains requirements on the RedCap UE regarding RRC connection release with redirection procedure. RRC connection release with redirection is initiated by the *RRCRelease* message with redirection to E-UTRAN or NR from NR specified in TS 38.331 [2]. The RRC connection release with redirection procedure is specified in clause 5.3.8 of TS 38.331 [2].

#### 6.2.3A.2 Requirements

##### 6.2.3A.2.1 RRC connection release with redirection to NR

The requirements in clause 6.2.3.2.1 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements defined in clause 6.2.3.2.1 shall apply except that:

- Tidentify-NRas specified in Table 6.2.3A.2.1-1.

Table 6.2.3A.2.1-1: Time to identify target NR cell for RRC connection release with redirection to NR

|  |  |
| --- | --- |
| FR of target NR cell | Tidentify-NR |
| FR1 | MAX (680 ms, [12] x Trs) |
| Note: If the UE has been provided with higher layer signaling of *smtc2*specified in TS 38.331 [2] prior to the redirection command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell. | |

The HD-FDD UE shall meet the RRC connection release with redirection requirements provided that SSB is available at the UE once every SMTC period during Tsearch.

##### 6.2.3A.2.2 RRC connection release with redirection to E-UTRAN

The requirements in clause 6.2.3.2.2 shall apply.

**--- End of change 11 ---**

**--- Start of change 12 ---**

7.1A UE transmit timing for RedCap

### 7.1A.1 Introduction

The UE shall have capability to follow the frame timing change of the reference cell in connected state. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. UE initial transmit timing accuracy and gradual timing adjustment requirements are defined in the following requirements.

### 7.1A.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1A.2-1. This requirement applies:

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission.

The UE shall meet the Te requirement for an initial transmission provided that at least one SSB (CD-SSB or NCD-SSB) is available at the UE during the last 160 ms. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first detected path (in time) of the corresponding downlink frame is received from the reference cell. *N*TA for PRACH is defined as 0.

*Editor's: FFS whether SSB is in the active BWP or not*

 (in *Tc* units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3A was applied. *N*TA for other channels is not changed until next timing advance is received. The value ofdepends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). is defined in Table 7.1A.2-2.

Table 7.1A.2-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 1 | 15 | 15 | 12\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 10\*64\*Tc |
|  | 30 | 15 | 8\*64\*Tc |
|  |  | 30 | 8\*64\*Tc |
|  |  | 60 | 7\*64\*Tc |
| 2 | 120 | 60 | 3.5\*64\*Tc |
|  |  | 120 | 3.5\*64\*Tc |
|  | 240 | 60 | 3\*64\*Tc |
|  |  | 120 | 3\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

Table 7.1A.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 FDD or TDD band with neither E-UTRA–NR nor NB-IoT–NR coexistence case | 25600 (Note 1) |
| FR1 FDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 0 (Note 1) |
| FR1 TDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 39936 (Note 1) |
| FR2 | 13792 |
| Note 1: The UE identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [2]. If UE is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band.  Note 2: Void | |

When it is not the first transmission in a DRX cycle or there is no DRX cycle, and when it is the transmission for PUCCH, PUSCH and SRS transmission, the UE shall be capable of changing the transmission timing according to the received downlink frame of the reference cell except when the timing advance in clause 7.3A is applied.

#### 7.1A.2.1 Gradual timing adjustment

When the transmission timing error between the UE and the reference timing exceeds ±Te then the UE is required to adjust its timing to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.

2) The minimum aggregate adjustment rate shall be Tp per second.

3) The maximum aggregate adjustment rate shall be Tq per 200 ms.

where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 7.1A.2.1-1.

Table 7.1A.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2 | 60 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

7.2A UE timer accuracy for RedCap

### 7.2A.1 Introduction

UE timers are used in different protocol entities to control the UE behaviour.

### 7.2A.2 Requirements

For UE timers specified in TS 38.331 [2], the UE shall comply with the timer accuracies according to Table 7.2A.2-1.

The requirements are only related to the actual timing measurements internally in the UE. They do not include the following:

- Inaccuracy in the start and stop conditions of a timer (e.g. UE reaction time to detect that start and stop conditions of a timer is fulfilled), or

- Inaccuracies due to restrictions in observability of start and stop conditions of a UE timer (e.g. slot alignment when UE sends messages at timer expiry).

Table 7.2A.2-1

|  |  |
| --- | --- |
| Timer value [s] | Accuracy |
| timer value < 4 | ± 0.1s |
| timer value ≥ 4 | ± 2.5% |

7.3A Timing Advance for RedCap

### 7.3A.1 Introduction

The timing advance is initiated from gNB to UE configured with only PCell, with MAC message that implies the adjustment of the timing advance, as defined in clause 5.2 of TS 38.321 [7].

### 7.3A.2 Requirements

#### 7.3A.2.1 Timing Advance adjustment delay

UE shall adjust the timing of its uplink transmission at time slot *n*+ *k+1* for a timing advance command received in time slot *n*, and the value of *k* is defined in clause 4.2 in TS 38.213 [3]. The same requirement applies also when the UE is not able to transmit a configured uplink transmission due to the channel assessment procedure.

#### 7.3A.2.2 Timing Advance adjustment accuracy

The UE shall adjust the timing of its transmissions with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.3A.2.2-1, to the signalled timing advance value compared to the timing of preceding uplink transmission. The timing advance command step is defined in TS 38.213 [3].

Table 7.3A.2.2-1: UE Timing Advance adjustment accuracy

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc |

**--- End of change 12 ---**

**--- Start of change 13 ---**

8.1B Radio Link Monitoring for RedCap

### 8.1B.1 Introduction

The requirements in clause [8.1B] apply for radio link monitoring on UE with reduced capabilites:

- PCell in SA NR operation mode,

The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout,RedCap and Qin,RedCap for the purpose of monitoring downlink radio link quality of the cell.

The threshold Qout,RedCap is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout) as defined in Table [8.1B.1-1]. For SSB based radio link monitoring, Qout\_SSB,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table [8.1B.2.1-1]. For CSI-RS based radio link monitoring, Qout\_CSI-RS,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table [8.1B.3.1-1].

The threshold Qin,RedCap is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout,RedCap and shall correspond to the in-sync block error rate (BLERin,RedCap) as defined in Table [8.1B.1-1]. For SSB based radio link monitoring, Qin\_SSB,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table [8.1B.2.1-2]. For CSI-RS based radio link monitoring, Qin\_CSI-RS,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table [8.1B.3.1-2].

The out-of-sync block error rate (BLERout,RedCap) and in-sync block error rate (BLERin,RedCap) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table [8.1B.1-1] by default. All requirements in clause [8.1B] are applicable for BLER Configuration #0 in Table [8.1B.1-1].

Table 8.1B.1-1: Out-of-sync and in-sync block error rates for RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout,RedCap | BLERin,RedCap |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number  of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table [8.1B.1-2] according TS 38.213 [3], and meet the requirements as specified in clause [8.1B]. UE is not required to meet the requirements in clause [8.1B] if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1B.1-2: Maximum number of RLM-RS resources NRLM for RedCap UE

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell |  | Maximum number of RLM-RS resources, NRLM |
| FR1, ≤ 3 GHzNote | 4 | 2 |
| FR1, > 3 GHzNote | 8 | 4 |
| FR2 | 64 | 8 |
| NOTE: For unpaired spectrum operation with Case C - 30 kHz SCS, 3GHz is replaced by 1.88GHz, as specified in clause 4.1 in TS 38.213 [3]. | | |

### 8.1B.2 Requirements for SSB based radio link monitoring

#### 8.1B.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell, provided that the SSB configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause [8.1B.2.2].

Table 8.1B.2.1-1: PDCCH transmission parameters for out-of-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16; for 1 Rx RedCap.  8; for 2 Rx RedCap. |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| Bandwidth (PRBs) | 48; for 1 Rx RedCap.  24; for 2 Rx RedCap. |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

Table 8.1B.2.1-2: PDCCH transmission parameters for in-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8; for 1 Rx RedCap.  4; for 2 Rx RedCap. |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 48; for 1 Rx RedCap.  24; for 2 Rx RedCap. |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

#### 8.1B.2.2 Minimum requirement

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,RedCap [ms] period becomes worse than the threshold Qout\_SSB,RedCap within TEvaluate\_out\_SSB,RedCap [ms] evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB,RedCap [ms] period becomes better than the threshold Qin\_SSB,RedCap within TEvaluate\_in\_SSB,RedCap [ms] evaluation period.

TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap are defined in Table [8.1B.2.2-1] and Table [8.1B.2.2-3] for FR1 for UE with 2 Rx and 1 Rx, respectively.

TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap are defined in Table [8.1B.2.2-2] and Table [8.1B.2.2-4] for FR2 with scaling factor N=TBD for UE with 2 Rx and 1 Rx, respectively.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the SSB; and

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

For FR2,

- , when RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the RLM-RS is partially overlapped with measurement gap and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

-- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the RLM-RS resource outside measurement gap is

* not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,
* not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

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 8.1B.2.2-1: Evaluation period TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap for FR1 for 2 Rx RedCap

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,RedCap (ms) | TEvaluate\_in\_SSB,RedCap (ms) |
| no DRX | Max(200, Ceil(10 × P) × TSSB) | Max(100, Ceil(5 × P) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P) × TDRX | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

Table 8.1B.2.2-2: Evaluation period TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap for FR2 for 2 Rx RedCap

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,RedCap (ms) | TEvaluate\_in\_SSB,RedCap (ms) |
| no DRX | Max(200, Ceil(10 × P × N) × TSSB) | Max(100, Ceil(5 × P × N) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P × N) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P × N) × TDRX | Ceil(5 × P × N) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

Table 8.1B.2.2-3: Evaluation period TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap for FR1 for 1 Rx RedCap

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,RedCap (ms) | TEvaluate\_in\_SSB,RedCap (ms) |
| no DRX | Max([400], Ceil(20 × P) × TSSB) | Max(100, Ceil(5 × P) × TSSB) |
| DRX cycle≤320ms | Max([400], Ceil(30 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(20 × P) × TDRX | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

#### 8.1B.2.3 Measurement restrictions for SSB based RLM

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

For FR1, when the SSB for RLM 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 RLM 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 RLM without any restriction;

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

For FR2, when the SSB for RLM measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

### 8.1B.3 Requirements for CSI-RS based radio link monitoring

#### 8.1B.3.1 Introduction

The requirements in this clause apply for each CSI-RS based RLM-RS resource configured for PCell, provided that the CSI-RS configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause [8.1B.3.2]. UE is not expected to perform radio link monitoring measurements on the CSI-RS configured as RLM-RS if the CSI-RS is not in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.1B.3.1-1: PDCCH transmission parameters for out-of-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16; for 1 Rx RedCap.  8; for 2 Rx RedCap. |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 4dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

Table 8.1B.3.1-2: PDCCH transmission parameters for in-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8; for 1 Rx RedCap.  4; for 2 Rx RedCap. |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

#### 8.1B.3.2 Minimum requirement

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,RedCap ms period becomes worse than the threshold Qout\_CSI-RS,RedCap within TEvaluate\_out\_CSI-RS,RedCap ms evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_CSI-RS,RedCap ms period becomes better than the threshold Qin\_CSI-RS,RedCap within TEvaluate\_in\_CSI-RS,RedCap ms evaluation period.

- TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap are defined in Table [8.1B.3.2-1] and Table [8.1B.3.2-3] for FR1 for RedCap UE with 2 Rx and 1 Rx, respectively.

- TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap are defined in Table [8.1B.3.2-2] and Table [8.1B.3.2-4] for FR2 with scaling factor N=1 for RedCap UE with 2 Rx and 1 Rx, respectively.

The requirements of TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap apply provided that the CSI-RS for RLM is not in a resource set configured with repetition ON. The requirements do not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for RLM and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the CSI-RS; and

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

For FR2,

- P=1, when the RLM-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the RLM-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Note: The overlap between CSI-RS for RLM and SMTC means that CSI-RS based RLM is within the SMTC window duration.

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,RedCap and Min,RedCap used in Table [8.1B.3.2-1] and Table [8.1B.3.2-2] for UE with 2 Rx are defined as:

- Mout,RedCap = 20 and Min,RedCap = 10, 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.

The values of Mout,RedCap and Min,RedCap used in Table [8.1B.3.2-3] and Table [8.1B.3.2-4] for 1 Rx RedCap are defined as:

- Mout,RedCap = 40 and Min,RedCap = 10, 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 8.1B.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap for FR1 for 2 Rx RedCap

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS,RedCap (ms) | TEvaluate\_in\_CSI-RS,RedCap (ms) |
| no DRX | Max(200, Ceil(Mout,RedCap×P)×TCSI-RS) | Max(100, Ceil(Min,RedCap×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout,RedCap ×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min,RedCap×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout,RedCap ×P) × TDRX | Ceil(Min,RedCap ×P) × TDRX |
| NOTE: 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. | | |

Table 8.1B.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap for FR2 for 2 Rx RedCap

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS,RedCap (ms) | TEvaluate\_in\_CSI-RS,RedCap (ms) |
| no DRX | Max(200, Ceil(Mout,RedCap×P×N)×TCSI-RS) | Max(100, Ceil(Min,RedCap×P×N) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout,RedCap×P×N)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min,RedCap×P×N)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout,RedCap×P×N) × TDRX | Ceil(Min,RedCap×P×N) × TDRX |
| NOTE: 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. | | |

Table 8.1B.3.2-3: Evaluation period TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap for FR1 for 1 Rx RedCap

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS,RedCap (ms) | TEvaluate\_in\_CSI-RS,RedCap (ms) |
| no DRX | Max([400], Ceil(Mout,RedCap×P)×TCSI-RS) | Max(100, Ceil(Min,RedCap×P) × TCSI-RS) |
| DRX ≤ 320ms | Max([400], Ceil(1.5×Mout,RedCap ×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min,RedCap×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout,RedCap ×P) × TDRX | Ceil(Min,RedCap ×P) × TDRX |
| NOTE: 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. | | |

#### 8.1B.3.3 Measurement restrictions for CSI-RS based RLM

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

For both FR1 and FR2, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for RLM in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD, or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS for RLM measurement without restrictions.

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

For FR1, when the CSI-RS for RLM is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for RLM without any restriction.

For FR2, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, or L1-RSRP measurement, or in the same symbol as SSB for CBD when beam failure is detected, UE is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR2, when the CSI-RS for RLM measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- In the following cases, UE is required to measure one of but not both CSI-RS for RLM and the other CSI-RS. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

- The CSI-RS for RLM or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in q1 and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for RLM without any restriction.

### 8.1B.4 Minimum requirement at transitions

The requirements in clause 8.1.4 shall apply.

### 8.1B.5 Minimum requirement for UE turning off the transmitter

The requirements in clause 8.1.5 shall apply.

### 8.1B.6 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout,RedCap, layer 1 of the UE shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [2].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin,RedCap, layer 1 of the UE shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [2].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval,RedCap.

When DRX is not used for RedCap UEs, TIndication\_interval,RedCap is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause [8.1B.2] if the RLM-RS resource is SSB, or TCSI-RS specified in clause [8.1B.3] if the RLM-RS resource is CSI-RS.

In case DRX is used for RedCap UEs, TIndication\_interval,RedCap is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms. Upon start of T310 timer as specified in TS 38.331 [2], the UE shall monitor the configured RLM-RS resources for recovery using the evaluation period and layer 1 indication interval corresponding to the no DRX mode until the expiry or stop of T310 timer.

When DRX is not used for HD-FDD RedCap UEs, TIndication\_interval,RedCap is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1B.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 8.1B.3 if the RLM-RS resource is CSI-RS, under the following condition

* For each RLM-RS configuration, at least one RLM-RS sample must fall with DL occasion within an indication period.

In case DRX is used for HD-FDD RedCap UEs, TIndication\_interval,RedCap is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms, under the following conditioin

* For each RLM-RS configuration, at least one RLM-RS sample must fall with DL occasion within an indication period.

### 8.1B.7 Scheduling availability of UE during radio link monitoring

The requirements in clause 8.1.7 shall apply.

#### 8.1B.7.1 Scheduling availability of UE performing radio link monitoring with a same subcarrier spacing as PDSCH/PDCCH on FR1

The requirements in clause 8.1.7.1 shall apply.

#### 8.1B.7.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for radio link monitoring.

#### 8.1B.7.3 Scheduling availability of UE performing radio link monitoring on FR2

The following scheduling restriction applies due to radio link monitoring on an FR2 serving PCell.

- If the RLM-RS is CSI-RS which is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON,

- There are no scheduling restrictions due to radio link monitoring based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for RLM; and

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

**--- End of change 13 ---**

**--- Start of change 14 ---**

## 8.5B Link Recovery Procedures for Redcap

### 8.5B.1 Introduction

The Redcap UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set  as specified in TS 38.213 [3] in order to detect beam failure on PCell in SA.

The RS resource configurations in the set  on PCell can be periodic CSI-RS resources and/or 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 8.5B.2 and 8.5B.3 if UE does not have set .

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

The threshold Qout\_LR\_Redcap is defined as the level at which the downlink radio level link of a given resource configuration on set  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 8.5B.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5B.3.1-1.

Upon request the UE shall deliver configuration indexes from the set 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\_RedCap , which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR\_RedCap  threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR\_RedCap threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the set  can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. UE is not required to perform candidate beam detection outside the active DL BWP.

### 8.5B.2 Requirements for SSB based beam failure detection for Redcap

#### 8.5B.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set  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 8.5B.2.2.

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

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16 for 1 Rx UE; 8 for 2 Rx UE |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 48 for 1 Rx UE; 24 for 2 Rx UE |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note 1： Note: SCS=60kHz is not applicable for FR1 | |

#### 8.5B.2.2 Minimum requirement

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\_Redcap ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB\_Redcap ms period.

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

The value of TEvaluate\_BFD\_SSB\_Redcap is defined in Table 8.5B.2.2-2 for FR2 with scaling factor N=8

For FR1,

- , 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.

For FR2,

- , when BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by SSB-ToMeasure and 1 data symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and 1 data symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by ss-RSSI-Measurement and 1 data symbol before each RSSI symbol indicated by ss-RSSI-Measurement and 1 data symbol after each RSSI symbol indicated by ss-RSSI-Measurement, given that ss-RSSI-Measurement is configured.- Psharing factor = 3, otherwise.

where,

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*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, given the SMTC offset of all CCs in FR2 provided the same offset.

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 8.5B.2.2-1: Evaluation period TEvaluate\_BFD\_SSB\_Redcap for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_Redcap (ms) for Redcap UE with 2 Rx | TEvaluate\_BFD\_SSB\_Redcap (ms) for 1 Rx Redcap |
| no DRX | Max(50, Ceil(5 × P) × TSSB) | [ Max(50, Ceil(10 × P) × TSSB)] |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) | [ Max(50, Ceil(15 × P) × Max(TDRX,TSSB)) ] |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX | [ Ceil(10 × P) × TDRX] |
| ]Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | | |

Table 8.5B.2.2-2: Evaluation period TEvaluate\_BFD\_SSB\_Redcap for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_Redcap (ms) |
| no DRX | Max(50, Ceil(5 × P × N) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P × N) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5B.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 scenarios.

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.

For FR2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, 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.

For FR2, if the network configures same or mixed numerology between SSB for BFD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions on the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 8.5B.3 Requirements for CSI-RS based beam failure detection for Redcap

#### 8.5B.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  of resource configurations for a serving cell, provided that the CSI-RS resource(s) in set for beam failure detection are actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5B.3.2. UE is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.5B.3.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16 for 1 Rx UE; 8 for 2 Rx UE |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 for 1 Rx UE; 24 for 2 Rx UE |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note 1： Note: SCS=60kHz is not applicable for FR1 | |

#### 8.5B.3.2 Minimum requirement

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\_Redcap ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS\_Redcap ms period.

The value of TEvaluate\_BFD\_CSI-RS\_Redcap is defined in Table 8.5B.3.2-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS\_Redcap is defined in Table 8.5B.3.2-2 for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS\_Redcap apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , 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 CSI-RS.

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

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TCSI-RS < MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

where,

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*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the 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.

The values of MBFD used in Table 8.5B.3.2-1 and Table 8.5B.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in Table 8.5B.3.2-1 and Table 8.5B.3.2-2 are defined as

For each CSI-RS resource in the set  configured for PCell

- PBFD = 1.

**Table 8.5B.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS**\_Redcap **for FR1**

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS\_Redcap (ms) for Redcap UE with 2 Rx | TEvaluate\_BFD\_CSI-RS\_Redcap (ms) for 1 Rx Redcap |
| no DRX | Max(50, Ceil(MBFD × P × PBFD) × TCSI-RS) | Max(50, Ceil(2×MBFD × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) | Max(50, Ceil(2×1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × PBFD) × TDRX | Ceil(2×MBFD × P × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | | |

**Table 8.5B.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS**\_Redcap **for FR2**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS\_Redcap (ms) |
| no DRX | Max(50, Ceil(MBFD × P × N × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × N × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5B.3.3 Measurement restrictions for CSI-RS beam failure detection

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

For both FR1 and FR2, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

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

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for BFD measurement and the other CSI-RS. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

- The CSI-RS for BFD measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in set  and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

### 8.5B.4 Minimum requirement for L1 indication for Redcap

When the radio link quality on all the RS resources in set  is worse than Qout\_LR\_Redcap, layer 1 of the UE shall send a beam failure instance indication to the higher layers

The beam failure instance evaluation for the RS resources in set  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\_Redcap.

When DRX is not used, TIndication\_interval\_BFD\_Redcap is max(2ms, TSSB-RS,M) ) or max(2ms, TCSI-RS,M), where TSSB-RS,M and TCSI-RS,M is the shortest periodicity of all RS resources in set  for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set  or CSI-RS resource in the set .

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

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

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

When DRX is used, for CSI-RS based link quality measurement,

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

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

For HD-FDD UE, the above conditions and requirements TIndication\_interval\_BFD\_Redcap apply.

### 8.5B.5 Requirements for SSB based candidate beam detection for Redcap

#### 8.5B.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set  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 8.5.5.2.

#### 8.5B.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 ms period becomes better than the threshold Qin\_LR\_RedCap 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 8.5B.5.2-1 and 8.5B.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

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

The value of TEvaluate\_CBD\_SSB\_Redcap is defined in Table 8.5B.5.2-2 for FR2 with scaling factor N=8.

where,

For FR1,

- , 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.

For FR2,

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of the CBD-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 CBD 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 PCBD used in Table 8.5.5.2-1 and Table 8.5.5.2-2 are defined as

For each SSB resource in the set  configured for PCell

- PCBD = 1.

**Table 8.5B.5.2-1: Evaluation period TEvaluate\_CBD\_SSB**\_Redcap **for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

**Table 8.5.5.2-2: Evaluation period TEvaluate\_CBD\_SSB**\_Redcap **for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × N × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × N × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5B.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.

For FR2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, 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.

For FR2, if network configures same or mixed numerology between SSB for CBD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 8.5B.6 Requirements for CSI-RS based candidate beam detection for Redcap

#### 8.5B.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5B.6.2.

#### 8.5B.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set  estimated over the last TEvaluate\_CBD\_CSI-RS\_Redcap [ms] period becomes better than the threshold Qin\_LR\_RedCap within TEvaluate\_CBD\_CSI-RS\_Redcap [ms] period provided CSI-RS Ês/Iot is according to Annex Table B.2.4.2 for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.5B.6.2-1 and 8.5B.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_CSI-RS\_Redcap is defined in Table 8.5B.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS\_Redcap is defined in Table 8.5B.6.2-2 for FR2 with scaling factor N=8.

For FR1,

- , 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 CSI-RS; and

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

For FR2,

- P = 1, when candidate beam detection RS is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P =Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- ,, when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- ,, when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for CBD and SMTC means that CSI-RS for CBD is within the SMTC window duration.

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

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 8.5.6.3.

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 CBD 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 MCBD used in Table 8.5B.6.2-1 and Table 8.5B.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set  is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PCBD used in Table 8.5B.6.2-1 and Table 8.5B.6.2-2 are defined as

For each CSI-RS resource in the set  configured for PCell

- PCBD = 1.

**Table 8.5B.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS**\_Redcap **for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

**Table 8.5B.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS**\_Redcap **for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × N × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × N × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5B.6.3 Measurement restriction for CSI-RS based candidate beam detection

For both FR1 and FR2, when the CSI-RS for CBD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for CBD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS based CBD measurement for without restrictions.

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

For FR1, when the CSI-RS for CBD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for CBD measurement without any restriction.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and the other CSI-RS. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

### 8.5B.7 Scheduling availability of UE during beam failure detection for Redcap

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

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

There are no scheduling restrictions due to beam failure detection performed on SSB and CSI-RS configured for BFD with the same SCS as PDSCH or PDCCH in FR1.

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

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to beam failure detection when SSB is configured as BFD. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to beam failure detection when SSB is configured as BFD.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for beam failure detection.

#### 8.5B.7.3 Scheduling availability of UE performing beam failure detection on FR2

The following scheduling restriction applies due to beam failure detection.

- For the case where no RSs are provided for BFD, or when CSI-RS is configured for BFD is explicitly configured and is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON

- There are no scheduling restrictions due to beam failure detection performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for beam failure detection.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for BFD mesurement.

### 8.5B.8 Scheduling availability of UE during candidate beam detection for Redcap

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

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

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as link recovery detection resource with the same SCS as PDSCH or PDCCH in FR1.

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

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as link recovery detection resource. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured as link recovery detection resource.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, TRS, CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for L1-RSRP.

#### 8.5B.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to candidate beam detection

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for CBD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for CBD mesurement.

### 8.5B.9 Minimum requirement at transitions for beam failure detection for Redcap

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each BFD-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each BFD-RS resource.

When the UE transitions from a first configuration of BFD resources to a second configuration of BFD resources that is different from the first configuration, for each BFD resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each BFD resource present in the second configuration.

When the UE transitions from a first configuration of active TCI state of the CORESET to a second configuration of active TCI state of the CORESET, for each CSI-RS for BFD present in the second configuration, the UE shall use an evaluation period corresponding to the second configuration from the time of transition.

**--- End of change 14 ---**

**--- Start of change 15 ---**

8.6A Active BWP switch delay for RedCap

*Big CR Editor’s Note: Placeholder for BWP switch delay requirements.*

8.10B Active TCI state switching delay for RedCap

*Big CR Editor’s Note: Placeholder for TCI state switching delay requirements.*

**--- End of change 15 ---**

**--- Start of change 16 ---**

## 8.12A Uplink spatial relation switch delay for RedCap

*Big CR Editor’s Note: Placeholder for Uplink spatial relation switch delay requirements.*

**--- End of change 16 ---**

**--- Start of change 17 ---**

8.13A UE-specific CBW change for RedCap

*Big CR Editor’s Note: Placeholder for CBW change requirements.*

**--- End of change 17 ---**

**--- Start of change 18 ---**

9.1A General measurement requirement for RedCap

### 9.1A.1 Introduction

This clause contains general requirements on the RedCap UE regarding measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency, inter-frequency, inter-RAT E-UTRAN FDD, inter-RAT E-UTRAN TDD, and L1-RSRP measurements requirements. These measurements may be used by the NG-RAN. The measurement quantities are defined in TS38.215 [4], the measurement model is defined in TS38.300 [10], TS37.340 [17] and measurement accuracies are specified in clause 10. Control of measurement reporting is specified in TS 38.331 [2].

*Editor’s note: In this clause, the SSB* *terminology applies for both CD-SSB and NCD-SSB, yet this depends on the RAN4’s further discussion.*

*Editor’s note:* *further clarification on SSB number is needed (including CD-SSB and NCD-SSB in total or either CD-SSB or NCD-SSB).*

### 9.1A.2 Measurement gap

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide either per-FR measurement gap patterns for frequency range where UE requires per-FR measurement gap for concurrent monitoring of all frequency layers of each frequency range independently, or a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers of all frequency ranges.

During the per-UE or per-FR measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding NR serving cell for SA (with single carrier) except the reception of signals used for RRM measurement(s), and the signals used for random access procedure according to [7].

UEs shall support the measurement gap patterns listed in Table [9.1A.2-1] based on the applicability specified in Table [9.1A.2-2]. UE determines measurement gap timing based on gap offset configuration and measurement gap timing advance configuration provided by higher layer signalling as specified in TS 38.331 [2] and TS 36.331 [16].

Table 9.1A.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 5.5 | 20 |
| 13 | 5.5 | 40 |
| 14 | 5.5 | 80 |
| 15 | 5.5 | 160 |
| 16 | 3.5 | 20 |
| 17 | 3.5 | 40 |
| 18 | 3.5 | 80 |
| 19 | 3.5 | 160 |
| 20 | 1.5 | 20 |
| 21 | 1.5 | 40 |
| 22 | 1.5 | 80 |
| 23 | 1.5 | 160 |

Table 9.1A.2-2: Applicability for Gap Pattern Configurations supported by the RedCap UE with NR standalone operation (with single carrier)

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement Purpose | Applicable Gap Pattern Id |
|  | FR1 | non-NR RAT NOTE2 | 0,1,2,3 |
|  |  | FR1 and/or FR2 | 0-11 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| Per-UE measurement | FR2 | non-NR RATonly  NOTE2 | 0,1,2,3 |
| gap |  | FR1 only | 0-11 |
|  |  | FR1 and FR2 | 0-11 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  |  | FR2 only | 12-23 |
|  | FR1 if configured | non-NR RATonly | 0,1,2,3 |
|  | FR2 if configured | NOTE2 | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| gap | FR2 if configured | FR1 NOTE2 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 NOTE2 | 12-23 |
|  | FR1 if configured | non-NR RATand  FR1 and FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | 12-23 |
| NOTE1: If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among all serving cells subframes.  If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR1.  If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the measurement gap starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured measurement gap among serving cells.  NOTE 2: In RedCap, non-NR RAT means E-UTRA only. | | | |

*Editor’s note: There is only one searcher in RedCap and hence the case of Per-FR gap with no gap should not be considered. This shall be updated on RAN4 discussion outcome.*

If measurement gap is configured in one FR but measurement object is not configured in the FR, the scheduling opportunity in the FR depends on the configured measurement gap pattern.

For NR standalone operation (with single carrier), if UE is not capable of per-FR-gap, total interruption time on a serving cell during MGL is defined when MGL(N) = 6ms, 5.5ms, 4ms, 3.5ms, 3ms, and 1.5ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cell during MGL is defined only when MGL(N) = 6ms, 4ms, and 3ms, and total interruption time on FR2 serving cell during MGL is defined only when MGL(N) = 5.5ms, 3.5ms, and 1.5ms.



(a) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for serving cell in synchronous NR standalone operation (with single carrier)



(b) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for serving cell in synchronous NR standalone operation (with single carrier)

Figure 9.1A.2-1: Measurement GAP and total interruption time on serving cell for NR standalone operation (with single carrier)

The corresponding total number of interrupted slots on serving cell is listed in Table [9.1A.2-3] for all serving cell in NR standalone (with single carrier).

Table 9.1A.2-3: Total number of interrupted slots on serving cell during MGL for NR standalone operation (with single carrier) with per-UE measurement gap or per-FR measurement gap for FR1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cell | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | When MG timing advance of 0.5ms is applied | | |
| (kHz) | MGL=6ms | MGL=4ms | MGL=3ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 6 | 4 | 3 | 7Note3 | 5Note3 | 4Note3 |
| 30 | 12 | 8 | 6 | 12 | 8 | 6 |
| 60 | 24 | 16 | 12 | 24 | 16 | 12 |
| 120 | 48 | 32 | 24 | 48 | 32 | 24 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on serving cell is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: NR SCS of 120 kHz is only applicable to the case with per-UE measurement gap.  NOTE 3: Non-overlapped half-slots occur before and after the measurement gap. Whether a RedCap UE can receive and/or transmit in those half-slots is up to UE implementation. | | | | | | |

In case that UE capable of per-FR measurement gap is configured with per-UE measurement gap or per-FR measurement gap for FR2 serving cell, total number of interrupted slots on FR2 serving cells during MGL is listed in Table [9.1A.2-3a].

**Table 9.1A.2-3a: Total number of interrupted slots on FR2 serving cell during MGL for NR standalone operation (with single carrier) with per-UE measurement gap or per-FR measurement gap for FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on FR2 serving cell | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | When MG timing advance of 0.25ms is applied | | |
| (kHz) | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms |
| 60 | 22 | 14 | 6 | 22 | 14 | 6 |
| 120 | 44 | 28 | 12 | 44 | 28 | 12 |
| NOTE 1: The total number of interrupted slots is based on that SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter *refServCellIndicator* is an FR2 serving cell.  NOTE 2: Slot occurs before or after the measurement gap may be interrupted additionally if SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter refServCellIndicator is an FR1 serving cell. | | | | | | |

It is up to UE implementation whether or not the UE is able to conduct transmission in the following slot(s),

- when MGTA is not applied, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is other than 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the slot partially overlapped with measurement gap

where UL slot denotes that all the symbols in the slot are uplink symbols, and L=1 if  for the UL transmission is less than the length of one slot; L=2 otherwise.

Note: Network is supposed to take into account the possible difference between the estimated TA at network and actual TA at UE when scheduling UE in the above slot(s).

#### 9.1A.2.1 SA: Measurement Gap Sharing

*Editor’s note: RAN4 is still discussing whether CSI-RS based L3 measurement is supported in RedCap.*

For NR standalone UE configured with per-UE measurement gap, measurement gap sharing shall be applies when UE requires measurement gaps to identify and measure cells on an intra-frequency carrier or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers for [both] SSB [and CSI-RS based L3] measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps or per-FR measurement gap, and/or inter-RAT E-UTRAN carriers.

For NR standalone UE configured with per-FR1 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR1 intra-frequency carriers or when SMTC configured for FR1 intra-frequency measurement are fully overlapping with per-FR1 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR1 inter-frequency carriers for [both] SSB [and CSI-RS] based L3 measurement and/or inter-RAT E-UTRAN carriers, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR1 measurement gaps.

For NR standalone UE configured with per-FR2 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR2 intra-frequency carriers or when SMTC configured for FR2 intra-frequency measurement are fully overlapping with per-FR2 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR2 inter-frequency carriers for [both] SSB [and CSI-RS] based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps.

When network signals “01”, “10” or “11” with RRC parameter *MeasGapSharingScheme* [2] and the value of X is defined as in Table 9.1.2.1a-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

When network signals “00” indicating equal splitting gap sharing, X is not applied.

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause [9.1A.5.2.1].

### 9.1A.3 UE Measurement capability

#### 9.1A.3.1 SA: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE configured with SA NR operation mode.

When monitoring of multiple inter-RAT E-UTRAN carriers and inter-frequency NR carriers ([or without using gaps provided the UE supports such capability] or the effective MGRP is applied for per-FR measurement gap capable UE) is configured by PCell, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, [CSI-RSRP, CSI-RSRQ, CSI-SINR,] E-UTRAN RSRP, E-UTRAN RSRQ, E-UTRAN RS-SINR measurements, etc.) of detected cells on all the layers.

For UE configured with the NR SA operation, the effective total number of frequencies, excluding the frequencies of the PCell being monitored, is Nfreq, SA, RedCap, which is defined as:

Nfreq, SA, RedCap = Nfreq, SA, NR, RedCap + Nfreq, SA, E-UTRA, RedCap ,

where

Nfreq, SA, E-UTRA, RedCap is the number of E-UTRA inter-RAT carriers being monitored (FDD and TDD) as configured by PCell,

Nfreq, SA, NR, RedCap is the number of NR inter-frequency carriers being monitored as configured by PCell.

#### 9.1A.3.2 SA: Maximum allowed layers for multiple monitoring

If a UE is configured with SA NR operation mode, the UE shall be capable of monitoring at least:

- Depending on UE capability, 6 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 7 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

- Depending on UE capability, 6 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 6 E-UTRA FDD inter-RAT carriers configured by PCell.

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least [10] effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, and E-UTRA TDD layers.

The number of SSB frequency layers equals to the total number of MOs with

- *ssb-ConfigMobility* configured[, or ]

[- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB]*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

[The number of CSI-RS frequency layers equals to the number of MOs with *csi-rs-ResourceConfigMobility* configured assuming single MO is configured per frequency layer.]

### 9.1A.4 Capabilities for Support of Event Triggering and Reporting Criteria

#### 9.1A.4.1 Introduction

This clause contains requirements on UE capabilities for support of event triggering and reporting criteria. As long as the measurement configuration does not exceed the requirements stated in clause [9.1A.4.2], the UE shall meet all other performance requirements defined in clause 9 and clause 10.

The UE can be requested to make measurements under different measurement identities defined in TS 38.331 [2]. Each measurement identity corresponds to either event-based reporting, periodic reporting, or no reporting. In case of event-based reporting, each measurement identity is associated with an event triggering criterion. In case of periodic reporting, a measurement identity is associated with one periodic reporting criterion. In case of no reporting, a measurement identity is associated with one no reporting criterion.

The purpose of this clause is to set some limits on the number of different event triggering, periodic, and no reporting criteria the UE may be requested to track in parallel.

#### 9.1A.4.2 Requirements

In this clause a reporting criterion corresponds to either one event (in the case of event-based reporting), or one periodic reporting criterion (in case of periodic reporting), or one no reporting criterion (in case of no reporting). For event-based reporting, each instance of event, with the same or different event identities, is counted as separate reporting criterion in Table [9.1A.4.2-1].

The UE shall be able to support in parallel per category up to Ecat reporting criteria according to Table [9.1A.4.2-1]. For the measurement categories belonging to intra-frequency, inter-frequency, and inter-RAT measurements (i.e. without counting other categories that the UE shall always support in parallel), the UE need not support more than the total number of reporting criteria as follows:

- For UE configured with SA operation mode: , where

 is the total number of NR reporting criteria according to Table [9.1A.4.2-1],

 is the total number of inter-RAT E-UTRA reporting criteria according to Table [9.1A.4.2-1].

Table 9.1A.4.2-1: Requirements for reporting criteria per measurement category

|  |  |  |
| --- | --- | --- |
| Measurement category | Ecat | Note |
| Intra-frequency Note 1 | 9 | Events for any one or a combination of intra-frequency SS-RSRP, SS-RSRQ, SS-SINR, [CSI-RSRP, CSI-RSRQ, and CSI-SINR] for NG-RAN intra-frequency cells |
| Inter-frequency Note 1 | 10 | Events for any one or a combination of inter-frequency SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, and CSI-SINR for NG-RAN inter-frequency cells |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) Note 1 | 10 | Only applicable for UE with this (inter-RAT) capability. These reporting criteria apply for any E-UTRA carrier frequencies. |
| NOTE 1: Applicable for UE configured with SA NR operation mode. | | |

### 9.1A.5 Carrier-specific scaling factor

This clause specifies the derivation of carrier-specific scaling factor (CSSF) values, which scales the measurement delay requirements given in clause [9.2B],[9.3B], [9.4A], and [CSI-RS based L3 measurement in clause 9.10] when UE is configured to monitor multiple measurement objects. The CSSF values are categorized into CSSFoutside\_gap\_RedCap,i andCSSFwithin\_gap\_RedCap,i, for the measurements conducted outside measurement gaps and within measurement gaps, respectively.

*Editor’s note: RAN4 is still discussing whether CSI-RS based L3 measurement is supported in RedCap.*

#### 9.1A.5.1 Monitoring of multiple layers outside gaps

The carrier-specific scaling factor CSSFoutside\_gap\_RedCap,i for measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement with no measurement gap in clause [9.2B.5], when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement with no measurement gap in clause [9.2B.5], when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

[- CSI-RS based intra-frequency measurement in clause [9.10A.2], when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap.]

[- CSI-RS based intra-frequency measurement in clause [9.10A.2], when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap.]

*Editor’s note: inter-frequency measurement without gap is still under discussion in RAN4.*

UE is expected to conduct the measurement of this measurement object *i* only outside the measurement gaps.

The number of frequency layers for SSB measurements shall include the total number of MOs with

- *ssb-ConfigMobility* configured[, or ]

[- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.]

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFoutside\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

[- The starting point of the first 5ms window for CSI-RS measurement as defined in clause 9.10.1 on all CCs in FR2 is same and one of following conditions is met]

[- If any CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC, ]

[- All CCs with CSI-RS resources only in the first 5ms window have the same CSI-RS resource periodcity, and]

[- All CCs with CSI-RS resources both in the first and the second 5ms window have the same CSI-RS resource periodcity]

[- If no CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC, ]

[- The total number of different CSI-RS resources periodicities on all serving CCs does not exceed 3]

##### 9.1A.5.1.1 SA mode: carrier-specific scaling factor for SSB-based[, and CSI-RS based L3] measurements performed outside gaps

For UE in SA operation mode, the carrier-specific scaling factor CSSFoutside\_gap\_RedCap,i for intra-frequency SSB-based measurements[, intra-frequency CSI-RS L3 measurement] will be specified as follows:

CSSFoutside\_gap\_RedCap,i = 1[+NPCC\_CSIRS]

[- NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.]

*Editor’s note: RAN4 is still discussing whether CSI-RS based L3 measurement is supported in RedCap.*

#### 9.1A.5.2 Monitoring of multiple layers within gaps

The carrier-specific scaling factor CSSFwithin\_gap\_RedCap,i for a measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause [9.2B.5], when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement object with measurement gap in clause [9.2B.6].

[- CSI-RS based inter-frequency measurement in clause [9.10.3], when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap.]

[- CSI-RS based inter-frequency measurement in clause [9.10.3], when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap.]

- SSB-based inter-frequency measurement object with measurement gap in clause [9.3B.4].

- E-UTRA Inter-RAT measurement object in clauses [9.4A.2] and [9.4A.3].

*Editor’s note: RAN4 is still discussing whether CSI-RS based L3 measurement is supported in RedCap*

UE is expected to conduct the measurement of this measurement object *i* only within the measurement gaps.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

Number of SSB layers should include SSB for mobility and that as associated SSB for CSI-RS mobility. the ssbfrequency is counted only once if the ssbfrequency for mobility and associated SSB are the same, or ssbfrequency and smtc in multiple MOs are the same.

##### 9.1A.5.2.1 SA mode: carrier-specific scaling factor for SSB[, and CSI-RS-based L3] measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap\_RedCap,i and is derived as described in this clause.

For each measurement gap *j* count the total number of intra-frequency measurement object and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement object, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

[- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.]

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra\_RedCap,i,j: Number of intra-frequency measurement objects, [including both SSB, and CSI-RS based measurements,] which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter\_RedCap,i,j : Number of NR inter-frequency layers [including both SSB and CSI-RS based,] and EUTRA inter-RAT, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter\_RedCap,i,j equals 0.

- Mtot\_RedCap,i,j = Mintra\_RedCap,i,j + Minter\_RedCap,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot\_RedCap,i,j equals 0.

The carrier specific scaling factor CSSFwithin\_gap\_RedCap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap\_RedCap,i= max(ceil(Ri×Mtot\_RedCap,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Ri×Kintra×Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Ri×Kinter×Minter\_RedCap,i,j) in gaps where Mintra\_RedCap,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter\_RedCap,i,j)in gaps where Mintra\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a.

### 9.1A.6 Minimum requirement at transitions

When the measurement on one intra-frequency measurement object transitions from measurements performed outside gaps to measurements performed within gaps or vice versa during one measurement period, the cell identification and measurement period requirements with the longer delay apply.

The carrier-specific scaling factor specified in clause [9.1A.5] that applies to the other impacted measurement objects will also apply based on the longer measurement or cell identification delay before or after the transition.

When the UE transitions between DRX and non-DRX or when DRX cycle periodicity changes, the cell identification and measurement period requirements apply based on the longer delay before or after the transition.

Subsequent to this measurement period, the cell identification and measurement period requirements on each measurement object are corresponding to the second mode after transition.

**--- End of change 18 ---**

**--- Start of change 19 ---**

9.2B NR intra-frequency measurements for RedCap

### 9.2B.1 Introduction

*Editor Notes: The definition of RedCap intra-frequency measurement is FFS.*

A measurement is defined as a SSB based intra-frequency measurement provided [the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same], and the subcarrier spacing of the two SSBs are also the same.

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the SSB is completely contained in the active BWP of the UE[, or]

[- the active downlink BWP is initial BWP [3]].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause [9.2B.5.3].

SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25ms for frequency range FR2.

*Editor’s note: In this clause, the SSB terminology applies for both CD-SSB and NCD-SSB, yet this depends on the RAN4’s further discussion.*

*Editor’s note:* *further clarification on SSB number is needed (including CD-SSB and NCD-SSB in total or either CD-SSB or NCD-SSB).*

### 9.2B.2 Requirements applicability

The requirements in clause [9.2B] apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- For UE with 2 Rx:

- SS-RSRP related side conditions given in clauses 10.1.2 and 10.1.3 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7 and 10.1.8 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12 and 10.1.13 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

- For UE with 1 Rx:

- SS-RSRP related side conditions given in clauses TBD and TBD for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses TBD and TBD for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses TBD and TBD for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding Band.

### 9.2B.3 Number of cells and number of SSB

#### 9.2B.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2B.3.2 Requirements for FR2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band.

### 9.2B.4 Measurement Reporting Requirements

#### 9.2B.4.1 Periodic Reporting

For UE with 2 Rx: The requirements in clause [9.2.4.1] shall apply.

For UE with 1 Rx: Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses [10.1.2.1] (RSRP for FR1), [10.1.3.1] (RSRP for FR2), [10.1.7.1] (RSRQ for FR1), [10.1.8.1] (RSRQ for FR2), [10.1.12.1] (RS-SINR for FR1) and [10.1.13.1] (RS-SINR for FR2).

#### 9.2B.4.2 Event-triggered Periodic Reporting

For UE with 2 Rx: The requirements in clause 9.2.4.2 shall apply.

For UE with 1 Rx: Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses [10.1.2.1] (RSRP for FR1), [10.1.3.1] (RSRP for FR2), [10.1.7.1] (RSRQ for FR1), [10.1.8.1] (RSRQ for FR2), [10.1.12.1] (RS-SINR for FR1) and [10.1.13.1] (RS-SINR for FR2).

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause [9.2B.4.3].

#### 9.2B.4.3 Event Triggered Reporting

For UE with 2 Rx: The requirements in clause 9.2.4.3 shall apply.

For UE with 1 Rx: Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses [10.1.2.1] (RSRP for FR1), [10.1.3.1] (RSRP for FR2), [10.1.7.1] (RSRQ for FR1), [10.1.8.1] (RSRQ for FR2), [10.1.12.1] (RS-SINR for FR1) and [10.1.13.1] (RS-SINR for FR2).

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index\_RedCap or T identify intra without index\_RedCap defined in clause [9.2B.5.1] or clause [9.2B.6.2].When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap as defined in clause [9.2B.5.1] or clause [9.2B.6.2]. If a cell which has been detectable at least for the time period Tidentify intra without index\_RedCap or Tidentify intra with index\_RedCap defined in clause [9.2B.5.1] or clause [9.2B.6.2] becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_RedCap provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.2B.5 Intra-frequency measurements without measurement gaps for RedCap

#### 9.2B.5.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index\_RedCap if the UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_RedCap. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_RedCap. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

Tidentify\_intra\_without\_index\_RedCap = (TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap) ms

Tidentify\_intra\_with\_index\_RedCap = (TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap + TSSB\_time\_index\_intra\_RedCap) ms

Where:

TPSS/SSS\_sync\_intra\_RedCap: it is the time period used in PSS/SSS detection given in tables [9.2B.5.1-1], [9.2B.5.1-2], [9.2B.5.1-3].

TSSB\_time\_index\_intra\_RedCap: it is the time period used to acquire the index of the SSB being measured given in tables [9.2B.5.1-4], [9.2B.5.1-5]

T SSB\_measurement\_period\_intra\_RedCap: equal to a measurement period of SSB based measurement given in table [9.2B.5.2-1], table [9.2B.5.2-2], table [9.2B.5.2-3].

CSSFintra\_RedCap: it is a carrier specific scaling factor and is determined

according to CSSFoutside\_gap\_RedCap,i in clause [9.1A.5.1] for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap\_RedCap,i in clause [9.1A.5.2] for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

if the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

*Editor’s note: The final power class to be used for RedCap depends on the RF session outcome.*

For UE with 2 Rx:

Mpss/sss\_sync\_w/o\_gaps\_RedCap : For a UE supporting FR2 power class [5 or 6 or 7], Mpss/sss\_sync\_w/o\_gaps\_RedCap = [24].

Mmeas\_period\_w/o\_gaps\_RedCap : For a UE supporting power class [5 or 6 or 7], Mmeas\_period\_w/o\_gaps\_RedCap = [24].

When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

When intra-frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap

For FR2,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

Table 9.2B.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max( 600ms, ceil(5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-2: Time period for PSS/SSS detection, (Frequency range FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-3: Time period for PSS/SSS detection, (Frequency range FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | [max( TBDms, ceil( TBD x Kp) x SMTC period )Note 1 x CSSFintra\_RedCap] |
| DRX cycle≤ 320ms | [max( TBDms, ceil(TBD x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap] |
| DRX cycle>320ms | [ceil(TBD x Kp) x DRX cycle x CSSFintra\_RedCap] |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

**Table 9.2B.5.1-4: Time period for time index detection (FR1)** **for 2 Rx RedCap**

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | [max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFintra\_RedCap] |
| DRX cycle≤ 320ms | [max(120ms, ceil (3 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap] |
| DRX cycle>320ms | [Ceil(3 x Kp) x DRX cycle x CSSFintra\_RedCap] |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

**Table 9.2B.5.1-5: Time period for time index detection (FR1) for 1 Rx RedCap**

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(TBDms, ceil( TBD x Kp )x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(TBDms, ceil (TBD x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | Ceil(TBD x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2B.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2B.5.2-1, 9.2B.5.2-2, 9.2B.5.2-3.

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for TSSB\_measurement\_period\_intra\_RedCap.

For FR2, a longer measurement period is allowed, if aperiodic CSI-RS resource is measured for L1-RSRP measurement on any FR2 serving frequency in the same band, and the CSI-RS resource is outside measurement gap and overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols. If *SSB-ToMeasure* or *SS-RSSI-Measurement* is configured, the SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same band which can be merged and the RSSI symbols are indicated by *SS-RSSI-Measurement*.

Table 9.2B.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.2-2: Measurement period for intra-frequency measurements without gaps (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps\_RedCap xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.2-3: Measurement period for intra-frequency measurements without gaps (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(TBDms, ceil( TBD x Kp) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(TBDms, ceil(1.5x TBD x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2B.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2B.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

##### 9.2B.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

##### 9.2B.5.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 intra-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration (The signaling *deriveSSB\_IndexFromCell* is always enabled for FR2). If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration (The signaling *deriveSSB\_IndexFromCellc* is always enabled for FR2). If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

If following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots.

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, the UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, the UE is expected to receive PDSCH that corresponds to the PDCCH that the UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured.

##### 9.2B.5.3.4 Scheduling availability of UE performing measurements in HD-FDD bands on FR1

When the UE performs intra-frequency measurements in a HD-FDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a HD-FDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

### 9.2B.6 Intra-frequency measurements with measurement gaps

#### 9.2B.6.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_RedCap. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_RedCap. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

Tidentify\_intra\_without\_index\_RedCap = TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap ms

Tidentify\_intra\_with\_index\_RedCap = TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap + TSSB\_time\_index\_intra\_RedCap ms

Where:

TPSS/SSS\_sync\_intra\_RedCap: it is the time period used in PSS/SSS detection given in table 9.2B.6.1-1 or 9.2B.6.1-2 or 9.2B.6.1-3.

TSSB\_time\_index\_intra\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.2B.6.1-4 or 9.2B.6.1-5.

T SSB\_measurement\_period\_intra\_RedCap: equal to a measurement period of SSB based measurement given in table 9.2B.6.2-1 or 9.2B.6.2-2 or 9.2B.6.2-3.

CSSFintra\_RedCap: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap\_RedCap,i in clause [9.1A.5.2] for measurement conducted within measurement gaps.

For UE with 2 Rx:

[Mpss/sss\_sync\_with\_gaps\_RedCap : For a UE supporting FR2 power class [5 or 6 or 7], Mpss/sss\_sync with\_gaps\_RedCap =[24].

Mmeas\_period\_ with\_gaps\_RedCap: For a UE supporting power class [5 or 6 or 7], Mmeas\_period\_ with\_gaps\_RedCap =[24].

*Editor’s note: The final power class to be used for RedCap depends on the RF session outcome.*

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap.

Table 9.2B.6.1-1: Time period for PSS/SSS detection (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, 5 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, 5 x max(MGRP, SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | 5 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

**Table 9.2B.6.1-2: Time period for PSS/SSS detection (FR2) for 2 Rx RedCap**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps\_RedCap x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps\_RedCap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra\_RedCap\_RedCap |
| DRX cycle>320ms | Mpss/sss\_sync\_with\_gaps\_RedCap x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-3: Time period for PSS/SSS detection (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(TBD ms, TBD x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(TBD ms, TBD x max(MGRP, SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | TBD x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-4: Time period for time index detection (Frequency range FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(120ms, 3 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(120ms, 3 x max(MGRP, SMTC period,DRX cycle) x CSSFintra\_RedCap) |
| DRX cycle>320ms | 3 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-5: Time period for time index detection (Frequency range FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(TBDms, TBD x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(TBDms, TBD x max(MGRP, SMTC period,DRX cycle) x CSSFintra\_RedCap) |
| DRX cycle>320ms | TBD x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

#### 9.2B.6.2 Intra-frequency Measurement Period

The measurement period for FR1 in-trafrequency measurements with gaps is as shown in table 9.2B.6.2-1.

The measurement period for FR2 intra-frequency measurements with gaps is as shown in table 9.2B.6.2-2.

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

Table 9.2B.6.2-1: Measurement period for intra-frequency measurements with gaps (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(200ms, 5 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5) x max(MGRP, SMTC period,DRX cycle))x CSSFintra\_RedCap |
| DRX cycle>320ms | 5 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.2-2: Measurement period for intra-frequency measurements with gaps (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(400ms, Mmeas\_period with\_gaps\_RedCap x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps\_RedCap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra\_RedCap |
| DRX cycle>320ms | Mmeas\_period with\_gaps\_RedCap x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.2-3: Measurement period for intra-frequency measurements with gaps (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(TBD ms, TBD x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(TBD ms, ceil(1.5x TBD) x max(MGRP, SMTC period,DRX cycle))x CSSFintra\_RedCap |
| DRX cycle>320ms | TBD x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

**--- End of change 19 ---**

**--- Start of change 20 ---**

9.3B NR inter-frequency measurements for RedCap

### 9.3B.1 Introduction

*Editor’s note: NCD-SSB measurement is being discussed and may need to be revised based on agreements.*

*Editor’s note Whether RedCap UE supports Inter-frequency without gap is being discussed and may need to be revised based on agreements.*

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause [9.2B].

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified inter-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which ends later than the gap end – switching time. When the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap or per-FR gap is configured to the UE in SA NR, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

Longer measurement period would be expected during the period Tidentify\_CGI\_RedCap when the UE is requested to decode an NR/E-UTRA CGI.

[In this clause, the SSB terminology applies for both CD-SSB and NCD-SSB, yet this depends on the RAN4’s further discussion.]

### 9.3B.2 Requirements applicability

The requirements in clause [9.3B] apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- For UE with 2 Rx:

- SS-RSRP related side conditions given in clauses 10.1.4 and 10.1.5 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9 and 10.1.10 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14 and 10.1.15 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

- For UE with 1 Rx:

- SS-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses TBD for FR1, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses TBD for FR1, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding Band.

### 9.3B.3 Number of cells and number of SSB

#### 9.3B.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

#### 9.3B.3.2 Requirements for FR2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3B.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_RedCap. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index\_RedCap.

Tidentify\_inter\_without\_index\_RedCap = (TPSS/SSS\_sync\_inter\_RedCap + T SSB\_measurement\_period\_inter\_RedCap) ms

Tidentify\_inter\_with\_index\_RedCap = (TPSS/SSS\_sync\_inter\_RedCap + T SSB\_measurement\_period\_inter\_RedCap + TSSB\_time\_index\_inter\_RedCap) ms

Where:

TPSS/SSS\_sync\_inter\_RedCap: it is the time period used in PSS/SSS detection given in table [9.3B.4-1], table [9.3B.4-2], table [9.3B.4-3].

TSSB\_time\_index\_inter\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table [9.3B.4-4], table [9.3B.4-5], table [9.3B.4-6].

TSSB\_measurement\_period\_inter\_RedCap: equal to a measurement period of SSB based measurement given in table [9.3B.5-1], table [9.3B.5-2], table [9.3B.5-3].

*Editor’s note: which power class to be used for RedCap depends on the RF session outcome.*

For UE with 2 Rx:

Mpss/sss\_sync\_inter\_RedCap: For a UE supporting FR2 power class 5,6,7, Mpss/sss\_sync\_inter\_RedCap = [40] samples.

MSSB\_index\_inter\_RedCap: For a UE supporting FR2 power class 5,6,7 MSSB\_index\_inter\_RedCap =[24] samples.

Mmeas\_period\_inter\_RedCap: For a UE supporting FR2 power class 5,6,7 Mmeas\_period\_inter\_RedCap =[40] samples.

CSSFinter\_RedCap: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap\_RedCap,i in clause [9.1A.5.2] for measurement conducted within measurement gaps.

**Table 9.3B.4-1: Time period for PSS/SSS detection (Frequency range FR1) for 2 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, 8 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

**Table 9.3B.4-2: Time period for PSS/SSS detection, (Frequency range FR2) for 2 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, Mpss/sss\_sync\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, (1.5 × Mpss/sss\_sync\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | Mpss/sss\_sync\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

**Table 9.3B.4-3: Time period for PSS/SSS detection (Frequency range FR1) for 1 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(TBDms, TBD × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(TBDms, Ceil(TBD \*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | TBD × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

**Table 9.3B.4-4: Time period for time index detection (Frequency range FR1) for 2 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(120ms, 3 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

**Table 9.3B.4-5: Time period for time index detection (Frequency range FR2) for 2 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(200ms, MSSB\_index\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(200ms, (1.5 × MSSB\_index\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | MSSB\_index\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

**Table 9.3B.4-6: Time period for time index detection (Frequency range FR1) for 1 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(TBDms, TBD × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(TBDms, Ceil(TBD × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | TBD × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

### 9.3B.5 Inter-frequency measurements

When measurement gaps are provided for inter frequency measurements, the 2 Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table [9.3B.5-1] and [9.3B.5-2].

**Table 9.3B.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1) for 2 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(200ms, 8 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

**Table 9.3B.5-2: Measurement period for inter-frequency measurements with gaps (Frequency FR2) for 2 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(400ms, Mmeas\_period\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(400ms, (1.5 × Mmeas\_period\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | Mmeas\_period\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

When measurement gaps are provided for inter frequency measurements, the 1 Rx RedCap physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses TBD, TBD, TBD, TBD, TBD and TBD, respectively, as shown in table [9.3B.5-3].

**Table 9.3B.5-3: Measurement period for inter-frequency measurements with gaps (Frequency FR1) for 1 Rx RedCap**

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(TBDms, TBD × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(TBDms, Ceil(TBD × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | TBD × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

### 9.3B.6 Inter-frequency measurements reporting requirements

#### 9.3B.6.1 Periodic Reporting

For UE with 2 Rx: The requirements in clause 9.3.6.1 shall apply.

For UE with 1 Rx: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses TBD, TBD, TBD, TBD, TBD and TBD, respectively.

#### 9.3B.6.2 Event-triggered Periodic Reporting

For UE with 2 Rx: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

For UE with 1 Rx: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses TBD, TBD, TBD, TBD, TBD and TBD, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause [9.3B.6.3].

#### 9.3B.6.3 Event-triggered Reporting

For UE with 2 Rx: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

For UE with 1 Rx: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses TBD, TBD, TBD, TBD, TBD and TBD, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index\_ RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_ RedCap. Both Tidentify\_inter\_without\_index\_ RedCap and Tidentify\_inter\_with\_index\_ RedCap are defined in clause [9.3B.4].When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index\_ RedCap or Tidentify\_intra\_with\_index\_ RedCap as defined in clause [9.2B.5.1] or clause [9.2B.6.2]. If a cell which has been detectable at least for the time period Tidentify intra without index\_ RedCap or Tidentify intra with index\_ RedCap defined in clause [9.2B.5.1] or clause [9.2B.6.2] becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_ RedCap provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

**--- End of change 20 ---**

**--- Start of change 21 ---**

9.4A Inter-RAT measurements for RedCap

### 9.4A.1 Introduction

The requirements in this clause are specified for NR−E-UTRAN FDD and NR−E-UTRAN TDD measurements and are applicable without an explicit E-UTRAN neighbour cell list containing physical layer cell identities, for a UE:

- in RRC\_CONNECTED state, and

- configured

- with SA operation mode by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR) on E-UTRA non-serving frequency carrier, and

- configured with an appropriate measurement gap pattern according to Table [9.1A.2-3].

Parameter TInter1\_RedCap used in inter-RAT requirements in clause [9.4A] is specified in Table [9.4A.1-1].

Table 9.4A.1-1: Minimum available time for inter-RAT measurements

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1\_RedCap, ms) |
| 0 | 6 | 40 | 60 |
| 1 | 6 | 80 | 30 |
| 2 | 3 | 40 | 24Note 1 |
| 3 | 3 | 80 | 12Note 1 |
| 4 | 6 | 20 | 120 Note 1 |
| 6 | 4 | 20 | 72 Note 1,3,6 |
| 7 | 4 | 40 | 36 Note 1,4,6 |
| 8 | 4 | 80 | 18Note 1,5,6 |
| 10 | 3 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1\_RedCap for gap pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1\_RedCap = 60 for gap pattern IDs 2, 4, 6, 7, 10, and Tinter1\_RedCap = 30 for gap pattern IDs 3 and 8 shall be used.  NOTE 2: Measurement gaps pattern configurations applicability is as specified in Table [9.1A.2-1].  NOTE 3: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 48 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 4: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 24 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 5: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 12 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 6: This gap pattern is applicable for E-UTRA inter-frequency measurements only if gap based NR measurements are also configured. | | | |

A UE configured with gap pattern ID 2, 3 or 10 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends not later than 500 μs before the end of the measurement gap in case of FDD and not later than 750 μs before the end of measurement gap in case of TDD.

A UE configured with gap pattern ID 6, 7 or 8 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends no later than 1500 μs before the end of the measurement gap in case of FDD and no later than 1750 μs before the end of measurement gap in case of TDD.

[In this clause, the SSB terminology applies for both CD-SSB and NCD-SSB, yet this depends on the RAN4’s further discussion.]

### 9.4A.2 NR − E-UTRAN FDD measurements

#### 9.4A.2.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN FDD cell is considered to be detectable when:

*Editor’s note: New reference clauses shall be specified for 1Rx.*

- For UE with 2 Rx:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

f- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

- For UE with 1 Rx:

- RSRP related conditions in the accuracy requirements in clause TBD are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.3] of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause TBD are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.3] of TS 36.133 [15],

- RS-SINR related conditions in the accuracy requirements in clause TBD are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.19] of TS 36.133 [15].

#### 9.4A.2.2 Requirements when no DRX is used

When the UE requires measurement gaps to identify and measure inter-RAT cells and an appropriate measurement gap pattern is scheduled, the UE shall be able to identify a new detectable FDD cell within TIdentify\_RedCap, E-UTRAN FDD according to the following expression:

,

where:

TBasicIdentify = 480 ms,

TInter1\_RedCap is defined in clause [9.4A.1],

CSSFinterRAT\_RedCap = CSSFwithin\_gap\_RedCap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause [9.1A.5.2].

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure\_RedCap, E-UTRAN FDD defined in Table [9.4A.2.2-1] and Table [9.4A.2.2-2] for UE with 2 Rx and 1 Rx, respectively.

**Table 9.4A.2.2-1:** M**easurement period and measurement bandwidth for 2 Rx RedCap**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure\_RedCap, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 480 x CSSFinterRAT\_RedCap | 6 |
| 1 (Note 1) | 240 x CSSFinterRAT\_RedCap | 50 |
| NOTE 1: This configuration is optional. | | |

**Table 9.4A.2.2-2:** M**easurement period and measurement bandwidth for 1 Rx RedCap**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure\_RedCap, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 960 x CSSFinterRAT\_RedCap | 6 |
| 1 (Note 1) | 480 x CSSFinterRAT\_RedCap | 50 |
| NOTE 1: This configuration is optional. | | |

The UE shall be capable of identifying and performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD carrier frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers.

If higher layer filtering is used, an additional cell identification delay can be expected.

For UE with 2 Rx:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause [10.2.2]. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [10.2.3]. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [10.2.5].

For UE with 1 Rx:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause TBD.

#### 9.4A.2.3 Requirements when DRX is used

When DRX is in use and measurement gaps are configured, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify\_RedCap, E-UTRAN FDD specified in Table [9.4A.2.3-1].

Table 9.4A.2.3-1: Requirement to identify a newly detectable E-UTRAN FDD cell

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify\_RedCap, E-UTRAN FDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4A.2.2 apply | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.256 | 5.12\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (30\*CSSFinterRAT\_RedCap) |
| 0.32 | 6.4\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (24\*CSSFinterRAT\_RedCap) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT\_RedCap) | Note1 (20\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure\_RedCap, E-UTRAN FDD specified in Table [9.4A.2.3-2] and Table [9.4A.2.3-3].

**Table 9.4A.2.3-2: Requirement to measure E-UTRAN FDD cells for 2 Rx RedCap**

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure\_RedCap, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (5\* CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | |

**Table 9.4A.2.3-3: Requirement to measure E-UTRAN FDD cells for 1 Rx RedCap**

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure\_RedCap, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (10\* CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | |

If higher layer filtering is used, an additional cell identification delay can be expected.

For UE with 2 Rx:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For UE with 1 Rx:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause TBD.

#### 9.4A.2.4 Measurement reporting requirements

##### 9.4A.2.4.1 Periodic Reporting

For UE with 2 Rx: The requirements in clause 9.4.2.4.1 shall apply.

For UE with 1 Rx: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses TBD, TBD, and TBD, respectively.

##### 9.4A.2.4.2 Event-Triggered Periodic Reporting

For UE with 2 Rx: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For UE with 1 Rx: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses TBD, TBD, and TBD, respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4A.2.4.3.

##### 9.4A.2.4.3 Event-Triggered Reporting

For UE with 2 Rx: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For UE with 1 Rx: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses TBD, TBD, and TBD, respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify\_RedCap, E-UTRAN FDD defined in clauses 9.4A.2.2 and 9.4A.2.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify\_RedCap, E-UTRAN FDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure\_RedCap, E-UTRAN FDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap has not been available and the L3 filter has not been used.

### 9.4A.3 NR − E-UTRAN TDD measurements

#### 9.4A.3.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN TDD cell is considered to be detectable when:

*Editor’s note: New reference clauses shall be specified for 1Rx.*

- For UE with 2 Rx:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

- For UE with 1 Rx:

- RSRP related conditions in the accuracy requirements in clause TBD are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause TBD are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause TBD are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4A.3.2 Requirements when no DRX is used

When the UE requires measurement gaps to identify and measure inter-RAT cells and an appropriate measurement gap pattern is scheduled, the UE shall be able to identify a new detectable TDD cell within TIdentify\_RedCap, E-UTRAN TDD according to the following expression:

- When configuration 0 or configuration 1 in Table [9.4A.3.2-1] is applied,

,

- When configuration 2 or configuration 3 in Table [9.4A.3.2-1] is applied,

,

where:

TBasicIdentify = 480 ms,

TInter1\_RedCap is defined in clause 9.4A.1,

CSSFinterRAT\_RedCap = CSSFwithin\_gap\_RedCap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause [9.1A.5.2].

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure\_RedCap, E-UTRAN TDD defined in Table [9.4A.3.2-1] and Table [9.4A.3.2-1] for UE with 2 Rx and 1 Rx, respectively.

Table 9.4A.3.2-1: TMeasure\_RedCap, E-UTRAN TDD for different configurations for 2 Rx RedCap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure\_RedCap, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 480 x CSSFinterRAT\_RedCap |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 240 x CSSFinterRAT\_RedCap |
| 2 | 6 | 1 | 3 |  |  | 720 x CSSFinterRAT\_RedCap |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 480 x CSSFinterRAT\_RedCap |
| NOTE 1: This configuration is optional. | | | | | | |

Table 9.4A.3.2-2: TMeasure\_RedCap, E-UTRAN TDD for different configurations for 1 Rx RedCap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure\_RedCap, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 960 x CSSFinterRAT\_RedCap |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 480 x CSSFinterRAT\_RedCap |
| 2 | 6 | 1 | 3 |  |  | 1440 x CSSFinterRAT\_RedCap |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 960 x CSSFinterRAT\_RedCap |
| NOTE 1: This configuration is optional. | | | | | | |

The UE shall be capable of identifying and performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD carrier frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers.

If higher layer filtering is used, an additional cell identification delay can be expected.

For UE with 2 Rx:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For UE with 1 Rx:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause TBD.

#### 9.4A.3.3 Requirements when DRX is used

When DRX is in use and measurement gaps are configured, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify\_RedCap, E-UTRAN TDD specified in Table 9.4A.3.3-1.

Table 9.4A.3.3-1: Requirement to identify a newly detectable E-UTRAN TDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify\_RedCap, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause [9.4A.3.2] apply | Non-DRX requirements in clause [9.4A.3.2] apply |
| 0.256 | 5.12\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (30\*CSSFinterRAT\_RedCap) |
| 0.32 | 6.4\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (24\*CSSFinterRAT\_RedCap) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT\_RedCap) | Note1 (20\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause [9.4A.3.2]. | | |

For 1 Rx RedCap UE, a cell shall be considered detectable provided following conditions are fulfilled:

- RSRP|dBm and RSRP Ês/Iot according to Annex B.2.3 in [15] for a corresponding Band,

- other RSRP related side conditions given in Clause 9.1.3.3 and 9.1.3.4 in [15] are fulfilled for a corresponding Band,

- RSRQ related side conditions given in Sections 9.1.6.5 and 9.1.6.6 in [15] are fulfilled for a corresponding Band,

- SCH\_RP|dBm SCH Ês/Iot according to Annex B.2.3 in [15] for a corresponding Band.

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure\_RedCap, E-UTRAN TDD specified in Table 9.4A.3.3-2 and Table 9.4A.3.3-3 for UE with 2 Rx and 1 Rx, respectively.

Table 9.4A.3.3-2: Requirement to measure E-UTRAN TDD cells for 2 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure\_RedCap, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause [9.4A.3.2] apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause [9.4A.3.2] apply,  Otherwise: Note1 (5\*CSSFinterRAT\_RedCap) |
| 0.128<DRX-cycle≤10.24 | Note1 (5\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.3.2.  NOTE 3: See Table [9.4A.3.2-1]. | |

Table 9.4A.3.3-3: Requirement to measure E-UTRAN TDD cells for 1 Rx RedCap

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure\_RedCap, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause [9.4A.3.2] apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause [9.4A.3.2] apply,  Otherwise: Note1 (5\*CSSFinterRAT\_RedCap) |
| 0.128<DRX-cycle≤10.24 | Note1 (10\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.3.2.  NOTE 3: See Table [9.4A.3.2-1]. | |

If higher layer filtering is used, an additional cell identification delay can be expected.

For UE with 2 Rx:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For UE with 1 Rx:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause TBD. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause TBD.

#### 9.4A.3.4 Measurement reporting requirements

##### 9.4A.3.4.1 Periodic Reporting

For UE with 2 Rx: The requirements in clause 9.4.3.4.1 shall apply.

For UE with 1 Rx: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses TBD, TBD, and TBD, respectively.

##### 9.4A.3.4.2 Event-Triggered Periodic Reporting

For UE with 2 Rx: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For UE with 1 Rx: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses TBD, TBD, and TBD, respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause [9.4A.3.4.3].

##### 9.4A.3.4.3 Event-Triggered Reporting

For UE with 2 Rx: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For UE with 1 Rx: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses TBD, TBD, and TBD, respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify\_RedCap, E-UTRAN TDD defined in clauses [9.4A.3.2] and [9.4A.3.3] without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify\_RedCap, E-UTRAN TDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure\_RedCap, E-UTRAN TDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap has not been available and the L3 filter has not been used.

### 9.4A.4 NR – E-UTRAN measurements with autonomous gaps

#### 9.4A.4.1 CGI identification of an E-UTRA cell with autonomous gaps

The requirements in this clause apply when the UE is configured with standalone NR with 2 Rx UE. The UE shall identify and report the CGI when requested by an NR PCell for the purpose ‘reportCGI’. The UE may make autonomous gaps in downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3.1 in TS 38.331 [2].

For 2 Rx RedCap UE: If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, the UE shall be able to identify a new CGI of E-UTRA cell within = 150 ms.

For 1 Rx RedCap UE: If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, the UE shall be able to identify a new CGI of E-UTRA cell within = 190 ms.

This is the maximum allowed time for the UE to identify a new CGI of an E-UTRA cell, provided that the E-UTRA cell has been already identified by the UE.

A cell shall be considered identifiable following conditions are fulfilled:

- RSRP related side conditions given in Clause 9.1 in [15] are fulfilled for a corresponding Band,

- SCH\_RP and SCH Ês/Iot according to Annex B.2.2 in [15] for a corresponding Band

The MIB of an E-UTRA cell whose CGI is identified shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to [25].

The requirement for identifying a new CGI of an E-UTRA cell within is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

#### 9.4A.4.2 CGI reporting delay

The E-UTRA CGI reporting delay is defined as the time between a command that will trigger an E-UTRA CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and an additional 30ms margin.

#### 9.4A.4.3 CGI reporting scheduling restriction

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period Tidentify\_CGI\_RedCap, E-UTRA specified in clause [9.4A.4.1], the UE shall be able to transmit at least the number of ACK/NACKs specified in Table [9.4A.4.3-1] on PCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 9.4A.4.3-1: Minimum number of ACK/NACKs transmitted by the UE during Tidentify\_CGI\_RedCap, E-UTRA

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | SCS | |
|  | Duplex mode configuration | SCS |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

**--- End of change 21 ---**

**--- Start of change 22 ---**

## 9.5B L1-RSRP measurements for Reporting for RedCap

### 9.5B.1 Introduction

The applicability of the requirements for performing L1-RSRP measurements for reporting in subclause 9.5B is defined in Section 3.6.

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for PCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.5B.2 Requirements applicability

The requirements in clause 9.5B apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

For 1 Rx RedCap:

- L1-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding band.

For 2 Rx RedCap:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

For 1 Rx RedCap:

- L1-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex TBD for a corresponding band.

For 2 Rx RedCap:

- L1-RSRP related side conditions given in clauses 10.1.19.2 and 10.1.20.2 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5B.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause TBD for FR1, for 1 Rx RedCap, and 10.1.19 for FR1 and 10.1.20 for FR2 for 2 Rx RedCap, if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause TBD for FR1, for 1 Rx RedCap, and 10.1.19 for FR1 and 10.1.20 for FR2 for 2 Rx RedCap. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in TBD for 1 Rx RedCap, and 10.1.6 for 2 Rx RedCap.

#### 9.5B.3.1 Periodic Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clause TBD for FR1.

For 2 Rx RedCap, reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5B.3.2 Semi-Persistent Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses TBD for FR1. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

For 2 Rx RedCap, reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5B.3.3 Aperiodic Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clause TBD.

For 2 Rx Redcap, reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5B.4 L1-RSRP measurement requirements

#### 9.5B.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5B.4.1-1 for FR1 and Table 9.5B.4.1-2 for FR2, for 2 Rx RedCap, and Table 9.5B.4.1-3 for FR1 for 1 Rx RedCap, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise.

- N= 8.

For FR1,

- P=, 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; and

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

For FR2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- P=, when S SSB is partially overlapped with measurement gap (TSSB <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

Where:

- TSSB = ssb-periodicityServingCell

- TSMTCperiod = the configured SMTC period

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*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of SSB, 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 L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5B.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5B.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5B.4.1-3: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

#### 9.5B.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap is defined in Table 9.5B.4.2-1 for FR1 and in Table 9.5B.4.2-2 for FR2, for 2 Rx RedCap, and in Table 9.5B.4.2-3 for 1 Rx RedCap, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured with QCL-TypeD for all resources in the resource set.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided with QCL-TypeD for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided *qcl-info* is configured for all resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause TBD.2 and TBD.2 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requirements apply provided *qcl-info* is configured with QCL-TypeD for all resources in the resource set.

For FR1,

- P=, 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 CSI-RS; and

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

For FR2,

- P=1, when CSI-RS is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- P=, when CSI-RS is not overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P=Psharing factor, when CSI-RS is not overlapped with measurement gap and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=1, when aperiodic CSI-RS resource is not overlapped with measurement gap

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with measurement gap (TCSI-RS < MGRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured

- Psharing factor = 3, otherwise.

Where:

TSMTCperiod = the configured SMTC period.

TCSI-RS = the periodicity of CSI-RS configured for L1-RSRP measurement

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*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for L1-RSRP measurement and SMTC means that CSI-RS for L1-RSRP measurement is within the SMTC window duration.

Longer evaluation period would be expected if the combination of CSI-RS, 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 L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5B.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

Table 9.5B.4.2-2: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

Table 9.5B.4.2-3: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

### 9.5B.5 Measurement restriction for CSI-RS and SSB for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5B.5.1 Measurement restriction for SSB based L1-RSRP

For FR1, when the SSB for L1-RSRP 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 L1-RSRP 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 L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for L1-RSRP measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

#### 9.5B.5.2 Measurement restriction for CSI-RS based L1-RSRP

For both FR1 and FR2, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for L1-RSRP measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

### 9.5B.6 Scheduling availability of UE during L1-RSRP measurement

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

#### 9.5B.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

For FD-FDD and TDD RedCap UEs, there are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

For HD-FDD RedCap UE, scheduling restrictions apply for transmission on PUCCH/PUSCH/SRS during the CBD evaluation period, as CBD evaluation is prioritized over UL transmission. The CBD evaluation period equals the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap in case L1-RSRP measurement is performed on SSB as defined in clause 9.5B.4.1, or TL1‑RSRP\_Measurement\_Period\_CSI‑RS\_RedCap in case L1-RSRP measurement is performed on CSI-RS and/or SSB as defined in clause 9.5B.4.1.

#### 9.5B.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- For FD-FDD and TDD RedCap UEs, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

- For HD-FDD RedCap UE, scheduling restrictions apply for transmission on PUCCH/PUSCH/SRS during the CBD evaluation period, as CBD evaluation is prioritized over UL transmission. The CBD evaluation period equals the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap in case L1-RSRP measurement is performed on SSB as defined in clause 9.5B.4.1, or TL1‑RSRP\_Measurement\_Period\_CSI‑RS\_RedCap in case L1-RSRP measurement is performed on CSI-RS and/or SSB as defined in clause 9.5B.4.1.

#### 9.5B.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- For the case where RS for L1-RSRP measurement is CSI-RS which is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.5B.4.2

- There are no scheduling restrictions due to L1-RSRP measurement performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

**--- End of change 22 ---**

**--- Start of change 23 ---**

## 9.11A NR measurements with autonomous gaps for RedCap

### 9.11A.1 Introduction

The requirements in this clause are applicable for CGI identification of an intra frequency and inter frequency NR target cell for 1 Rx RedCap in FR1. For 2 Rx RedCap, the requirements in clause 9.11 apply.

The requirements in this clause are specified for CGI identification of an NR target cell and are applicable for 1 Rx RedCap in FR1:

- in RRC\_CONNECTED state, and

- configured with SA operation mode and no SCell(s).

The overall CGI reporting delay is defined in clause 9.11A.3.

### 9.11A.2 CGI identification of an NR cell with autonomous gaps

*Editor’s Note: The scheduling restriction requirement of CGI reading will be captured in this section later.*

The RedCap UE shall identify and report the CGI of a known NR target cell when requested by the network for the purpose of reportCGI. Only one cell is provided to the RedCap UE with *cellForWhichToReportCGI* for identifying the CGI.The RedCap UE may make autonomous gaps in both downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3 of TS 38.331 [2]. Note that a RedCap UE is not required to use autonomous gap if *useAutonomousGaps* is set to false. If autonomous gaps are used for measurement with the purpose of reportCGI, regardless of whether DRX is used or not, the RedCap UE shall be able to identify a new CGI of NR cell within:

Tidentify\_CGI, RedCap = (TMIB, RedCap + T SIB1,RedCap) ms

Where:

TMIB,RedCap is the time period used to acquire MIB message. TMIB,RedCap = [TBD] \* TSMTC ms for target cell carrier frequency on FR1 and TMIB,RedCap = [TBD] \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1,RedCap is the time period used to acquire SIB1 message. TSIB1,RedCap = [TBD] \* TRMSI-scheduling ms.

Where TSMTC is the SMTC periodicity configured for the target cell measurement, and TRMSI-scheduling is

- the periodicity with which the SIB1 is actually transmitted by the NR target cell when SSB and RMSI CORESET multiplexing pattern is 1

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and TSMTC when SSB and RMSI CORESET multiplexing pattern is 2 or 3.

The requirement for identifying the CGI of an NR cell within Tidentify\_CGI,RedCap is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

Within the time Tidentify\_CGI,RedCap, over which the RedCap UE identifies the CGI of an NR cell, the RedCap UE shall fulfil interruption requirements specified in clause 8.2A.

In the requirement a cell is known if,

- During the last 5 seconds for FR1 or 3 seconds for FR2 before the reception of the report CGI command:

- The RedCap UE has sent a valid L3-RSRP measurement report with SSB index for the target cell and

- During MIB decoding at least reported SSBs remains detectable according to the cell identification conditions specified in clauses 9.2B or 9.3B of TS 38.133, and

- During SIB1 decoding the SSB used for MIB decoding remains detectable according to the cell identification conditions specified in clauses 9.2B or 9.3B of TS 38.133, and

- During MIB decoding, the SSB for MIB decoding remains detectable with SNR ≥[-3]dB

- During SIB1 decoding, the PDSCH for SIB1 decoding remains detectable with SNR ≥[-3]dB

### 9.11A.3 CGI reporting delay

The CGI reporting delay is defined as the time between a command that will trigger a CGI report and the point when the RedCap UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for RedCap UE to send the measurement report.

The CGI reporting delay shall be less than Tidentify\_CGI,RedCap defined in clause 9.11A.2 plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and additional 20ms margin if target cell is on FR2.

**--- End of change 23 ---**