**3GPP TSG-RAN4 Meeting #109R4-2321642**

**Chicago, USA, November 13 - 17, 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **-** | **rev** | **-** | **Current version:** | **18.3.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Draft big CR to TS 38.133 on NR NTN enhancement |
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| ***Source to WG:*** | Qualcomm Incorporated |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_NTN\_enh-Core |  | ***Date:*** | 2023-11-22 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | This big CR compiles the endoresed draft CRs listed below:Endorsed in RAN4#109:

|  |  |  |
| --- | --- | --- |
| TDoc Endorsed CR  | CR title | Source companies |
| R4-2321490 | Draft CR: Cell Re-selection for NR UE satellite access in RRC\_IDLE state | ZTE |
| R4-2321491 | Draft CR: Cell Re-selection for NR UE satellite access in RRC\_INACTIVE state | ZTE |
| R4-2318341 | Draft CR on RRC\_IDLE and RRC\_INACTIVE state mobility for NTN in above 10 GHz bands | CATT |
| R4-2321494 | DraftCR on measurement delay requirements for NTN bands above 10GHz | Xiaomi |
| R4-2321495 | Draft CR on VSAT UE timing requirements for NTN in above 10GHz | Samsung |
| R4-2321496 | draftCR on HO requirements for NTN in Ka band | Huawei, HiSilicon |
| R4-2321497 | draft Cat-B CR RLM in NTN band above 10GHz | Qualcomm Incorporated |
| R4-2321499 | draft CR on RRC\_CONNECTED state mobility for NTN | Vivo |

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| ***Summary of change:*** | Introduced core requirements for Rel-18 NR NTN enhancement. |
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| ***Consequences if not approved:*** | The requirements for R18 NR NTN enhancement are missing in TS38.133. |
|  |  |
| ***Clauses affected:*** | 4.2C, 5.1C, 9.2C.7, 9.2C.8, 9.3C.8, 9.3C.9, 9.3C.10, 9.5C.7, 9.5C.8, 9.5C.9, 7.1C 7.2C 7.3C, 6.1C.1.3, 6.1C.2.3, 8.1C, 6.1C.3, 6.1C.2.3 |
|  |  |
|  | **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:*** |  |

Start of Change 1

4.2C Cell Re-selection for NR UE for Satellite Access

4.2C.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it.

When the UE is in either *Camped* *Normally* state or *Camped on Any Cell* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency and inter-frequency cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may provide explicit neighbour list, or only carrier frequency information and bandwidth information. UE measurement activity is also controlled by measurement rules defined in TS 38.304 [1], allowing the UE to limit its measurement activity.

The requirements in this clause shall apply for the quasi-earth fixed cell and the earth moving cell.

Editor note: FFS on requirements/conditions for time based cell reselection for earth moving cell

The requirements in clause 4.2C apply to FR1-NTN and FR2-NTN as defined in TS 38.108 [37].

The requirements in clause 4.2C apply to FR2-NTN with the following assumption:

* no inter-satellite measurement is configured;
* single SAN Tx beam per radio cell in DL;
* same UE Rx beam is used for both serving and neighboring cells which belong to the same satellite.

4.2C.2 Requirements

4.2C.2.1 UE measurement capability

For idle mode cell re-selection purposes, the UE shall be capable of monitoring at least:

- Intra-frequency carrier, and

- Depending on UE capability, 7 NR inter-frequency carriers, and

4.2C.2.2 Measurement and evaluation of serving cell

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 and NSMTC =1, upon one SMTC configured at the UE,

- M1=2.5 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second and 1<NSMTC ≤ 4,

- otherwise M1=1.

Where, NSMTC is the number of SMTCs configured by SAN.

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 has evaluated according to Table 4.2C.2.2-1 in Nserv 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.

Additionally, if the UE is configured with ‘*t-service*’ [2], the UE shall start measurements of the neighbour cells indicated by the serving cell before ‘*t-service*’ is reached according to the requirements provided in clause 4.2C.2.3 and 4.2C.2.4.

Also,

- if *distanceThresh* and *referenceLocation* are configured by the network [2] and the UE supports location-based measurement initiation and has obtained its location information, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell if the distance between UE and the serving cell reference location – *referenceLocation ­–* is larger than *distanceThresh.* The requirements apply provided that the distance exceeds the *distanceThresh* by a margin of 50 m.

- if *distanceThresh* and *movingReferenceLocation* are configured by the network [2] and the UE supports location-based measurement initiation and has obtained its location information, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell if the distance between UE and the serving cell reference location – [*referenceLocation1*] *­–* is larger than *distanceThresh.* The requirements apply provided that the distance exceeds the *distanceThresh* by a margin of [X] m.

Editor’s note: FFS for location-based measurement initiation for cell reselection in earth-moving cell, a margin for beam footprint location is [20] meters.

If the UE is not configured with*‘t-Service*’ [2] in the serving cell and 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 for 10 s, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1].

If the UE is configured with ‘*t-Service*’ in the serving cell then the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 when any of the following conditions is fulfilled:

- 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 within 10 s since time instance T1 provided that ‘*t-Service*’ > T1 or

- 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 within 10 s since the time instance ‘*t-Service*’.

- Where, T1 is the time instance in seconds when the UE has determined that the serving cell does not fulfil the cell selection criterion S.

**Table 4.2C.2.2-1: Nserv**

|  |  |  |
| --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | **Nserv [number of DRX cycles]** |
|  | **FR1** |  |
| 0.32 | 1 | M1\*N1\*4 |
| 0.64 | M1\*N1\*4 |
| 1.28 | N1\*2 |
| 2.56 | N1\*2 |
| Note 1: The UE is not required to meet the requirements for 2.56s DRX cycle length for earth-moving LEO deployment. |

4.2C.2.3 Measurements of intra-frequency NR cells

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.

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, and the distance between UE and serving cell reference location is smaller than *distanceThresh* if the *distanceThresh* is configured (see TS 38.304[1]) and UE has location information, then the UE is not required to perform measurement of intra-frequency.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 [1] within Kmulti\_SMTC \* Tdetect,NR\_Intrawhen that Treselection= 0 if the UE does not support the feature for enhanced RRM requirements defined in TS38.306 [14] or if the *enhancedMeasurementLEO-r17* is not enabled, or within Kmulti\_SMTC \* Tdetect,NR\_Intra\_enhif the UE supports the feature for enhanced RRM requirements defined in TS38.306 [14] and the *enhancedMeasurementLEO-r17* is enabled. An intra frequency cell is considered to be detectable according to the conditions defined in Annex B.1.6 for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Kmulti\_SMTC \* Tmeasure,NR\_Intra (see table 4.2C.2.3-1) if the UE does not support the feature for enhanced RRM requirements defined in TS38.306 [14] or if the *enhancedMeasurementLEO-r17* is not enabled, or every Kmulti\_SMTC \* Tmeasure,NR\_Intra\_enh (see table 4.2C.2.3-2) if the UE supports the feature for enhanced RRM requirements defined in TS38.306 [14] and the *enhancedMeasurementLEO-r17* is enabled, 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/2.

For UE in FR1-NTN:

 If smtcs do not overlap with each other,

- $K\_{multi\\_SMTC}=1$, if GEO satellites are measured on the carrier;

- $K\_{multi\\_SMTC}=\left⌈\frac{N\_{LEO,i}}{N\_{LEO,simul}}\right⌉$, if LEO satellites are measured on the carrier;

- If smtcs partially overlap with each other,

- $K\_{multi\\_SMTC}=N\_{SMTC,overlap}$, if only GEO satellites are measured on the carrier;

- $K\_{multi\\_SMTC}=\sum\_{i=1}^{N\_{SMTC,overlap}}\left⌈\frac{N\_{LEO,i}}{N\_{LEO,simul}}\right⌉$, if only LEO satellites are measured on the carrier;

Where

- $N\_{LEO,i}$ Is the number of LEO satellites to be measured within i-th SMTC,

- $N\_{LEO,simul}$ Is the number of LEO satellites that UE can measure in parallel within an SMTC,

- $N\_{SMTC,overlap}$ Is the number of smtcs that partially overlap with each other.

Note: for deriving Kmulti\_SMTC for Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra, two SMTCs are considered as overlapping if they overlap in one or more occasions during a single Tdetect,NR\_Intra, Tmeasure,NR\_Intra or Tevaluate,NR\_Intra.

For UE in FR2-NTN, Kmulti\_SMTC = 1.

The parameter Kmulti\_SMTC is the scaling factor for measurements of multiple SMTCs which correspond to different satellites.

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 Kmulti\_SMTC \* Tevaluate,NR\_Intra if the UE does not support the feature for enhanced RRM requirements defined in TS38.306 [14] or if the *enhancedMeasurementLEO-r17* is not enabled, or within Kmulti\_SMTC \* Tevaluate,NR\_Intra\_enh if the UE supports the feature for enhanced RRM requirements defined in TS38.306 [14] and the *enhancedMeasurementLEO-r17* is enabled, when Treselection = 0as specified in table 4.2C.2.3-1 or table 4.2C.2.3-2 provided that:

- when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2.

- 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.

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

If Treselection timer has a nonzero 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.

**Table 4.2C.2.3-1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra****[s] (number of DRX cycles)** |
|  | **FR1** |  |  |  |
| 0.32 | 1 | 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 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: M2 = 2 if SMTC periodicity of measured intra-frequency cell > 20 ms and 1<NSMTC ≤ 4 upon more than 1 SMTC configured at the UE; M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms and NSMTC=1 upon 1 SMTC configured at the UE; otherwise M2=1. Where, NSMTC is the number of SMTCs configured by SAN 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: The UE is not required to meet the requirements for 2.56s DRX cycle length for earth-moving LEO deployment. |

**Table 4.2C.2.3-2: Tdetect,NR\_Intra\_enh, Tmeasure,NR\_Intra\_enh and Tevaluate,NR\_Intra\_enh**

|  |  |  |  |
| --- | --- | --- | --- |
| **DRX cycle length [s]** | **Tdetect,NR\_Intra\_enh [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_enh [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_enh [s] (number of DRX cycles)** |
|
| 0.32 |  2.56 x M2 (8 x M2)Note 1 | 0.32 x M3 (1 x M3) Note 1 | 0.96 x M4 (3 x M4) Note 1 |
| 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) |
| 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: When SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 2, M3 = M4 = 2.5 |

If ‘*t-Service*’ is broadcasted and applicable, UE shall be able to detect, measure, and evaluate neighbour cells before the serving cell stops serving the area regardless of whether the distance condition based on serving cell reference location is met or the legacy Srxlev/Squal condition are met, and when to start the detection, measurement and evaluation on neighbour cells is up to UE implementation. This requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of the last updated value for t-Service is acquired by the UE for the first time to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Ttrigger.

 Ttrigger = max(Tdetect,NR\_Intra, Kcarrier\* Tdetect,NR\_Inter),

where

- Kcarrier is the number of NR inter-frequency carriers indicated by the serving cell,

- Tdetect,NR\_Intra refers to intra-frequency cell detection delay in IDLE/INACTIVE mode defined Table Table 4.2C.2.3-2,

- Tdetect,NR\_Inter refers to inter-frequency cell detection delay in IDLE/INACTIVE mode defined Table 4.2C.2.4-2.

The requirements in this clause apply provided that the number of SMTCs for any inter-frequency carrier does not exceed the *parallelSMTC-r17*, otherwise UE may select one or subset of all the configured SMTCs sequentially for performing the measurements until all of the SMTCs can be measured. The selection of SMTCs to be used is up to UE implementation, and in this case, measurement period longer than the corresponding measurement period specified in Table 4.2C.2.3-1 and Table 4.2C.2.3-2 is expected.

4.2C.2.4 Measurements of inter-frequency NR cells

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, and the distance between UE and serving cell reference location is smaller than *distanceThresh* if *distanceThresh* is configured and UE has location information, 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 4.2C.2.9.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, or the distance between UE and serving cell reference location is larger than *distanceThresh* if *distanceThresh* is configured and UE has location information, then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. The requirements apply provided that the distance exceeds the *distanceThresh* by a margin of 50 m. 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 $\sum\_{i=1}^{K\_{carrier}}K\_{multi\\_SMTC,i}\*T\_{detect,NR\\_Inter}$ if the UE does not support the feature for enhanced RRM requirements defined in TS38.306 [14] or if the *enhancedMeasurementLEO-r17* is not enabled, or within $\sum\_{i=1}^{K\_{carrier}}K\_{multi\\_SMTC,i}\*T\_{detect,NR\\_Inter\\_enh}$ if the UE supports the feature for enhanced RRM requirements defined in TS38.306 [14] and the *enhancedMeasurementLEO-r17* is enabled, 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 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. The parameter Kcarrier is the number of NR inter-frequency carriers indicated by the serving cell.

The parameter Kmulti\_SMTC,i is the scaling factor for measurement of multiple SMTCs or multiple satellites.

For FR2-NTN, Kmulti\_SMTC,i = 1.

For UE in FR1-NTN:

- If SMTCs do not overlap with each other,

- $K\_{multi\_{SMTC},i}=1$, if GEO satellites are measured on the carrier;

- $K\_{multi\_{SMTC},i}=\left⌈\frac{N\_{LEO,i}}{N\_{LEO,simul}}\right⌉$, if LEO satellites are measured on the carrier;

- If SMTCs partially overlap with each other,

- $K\_{multi\_{SMTC},i}=N\_{SMTC,overlap}$, if only GEO satellites are measured on the carrier;

- $K\_{multi\_{SMTC},i}=\sum\_{i=1}^{N\_{SMTC,overlap}}\left⌈\frac{N\_{LEO,i}}{N\_{LEO,simul}}\right⌉$, if only LEO satellites are measured on the carrier;

where

$N\_{LEO,i}$ is the number of LEO satellites to be measured within i-th SMTC,

$N\_{LEO,simul}$ is the number of LEO satellites that UE can measure in parallel within an SMTC,$N\_{SMTC,overlap}$ is the number of SMTCs that partially overlap with each other.

Note: for deriving Kmulti\_SMTC,i for Tdetect,NR\_Inter, Tmeasure,NR\_Inter and Tevaluate,NR\_Inter of frequency layer *i*, two SMTCs are considered as overlapping if they overlap in one or more occasions during a single Tdetect,NR\_Inter, Tmeasure,NR\_Inter or Tevaluate,NR\_Inter.

An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B.1.7 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. 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 $\sum\_{i=1}^{K\_{carrier}}K\_{multi\\_SMTC,i}\*T\_{measure,NR\\_Inter}$ (see table 4.2C.2.4-1) if the UE does not support the feature for enhanced RRM requirements defined in TS38.306 [14] or if the *enhancedMeasurementLEO-r17* is not enabled, or every $\sum\_{i=1}^{K\_{carrier}}K\_{multi\\_SMTC,i}\*T\_{measure,NR\\_Inter\\_enh}$ (see table 4.2C.2.4-2) if the UE supports the feature for enhanced RRM requirements defined in TS38.306 [14] and the *enhancedMeasurementLEO-r17*is enabled, 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 $\sum\_{i=1}^{K\_{carrier}}K\_{multi\\_SMTC,i}\*T\_{evaluate,NR\\_Inter}$ if the UE does not support [capability for enhanced requriements] or if the [NW configuration for enhanced requirements] is not enabled, or within $\sum\_{i=1}^{K\_{carrier}}K\_{multi\\_SMTC,i}\*T\_{evaluate,NR\\_Inter\\_enh}$ if the UE supports the feature for enhanced RRM requirements defined in TS38.306 [14] and the *enhancedMeasurementLEO-r17* is enabled, when Treselection = 0as specified in table 4.2C.2.4-1 provided 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 [5]dB better ranked in FR1 or.

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 [5]dB better ranked in FR1 if the current serving cell is among them. 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.

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 4.2C.2.4-1 under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where

- TSMTC\_intra is the periodicity of the SMTC configured for the intra-frequency carrier if no identified intra-frequency cell is in the PCI list of smtc2-LP on this intra-frequency carrier; TSMTC\_intra is the periodicity of the smtc2-LP configured for the intra-frequency carrier if at least one identified intra-frequency cell is in the PCI list of smtc2-LP on this intra-frequency carrier. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed for TSMTC\_intra. If the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.

- TSMTC\_inter is the actual SMTC periodicity used by the inter-frequency cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the inter-frequency carrier is assumed for TSMTC\_inter. If the actual SSB transmission periodicity is greater than the SMTC configured for the inter-frequency carrier, longer Tdetect, NR\_inter is expected.

- 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].

**Table 4.2C.2.4-1: Tdetect,NR\_Inter, Tmeasure,NR\_Inter and Tevaluate,NR\_Inter**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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** |
| 0.32 | 1 | 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 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: UE is not required to fulfil the requirements for 2.56s DRX cycle length for earth-moving LEO deployment. |

**Table 4.2C.2.4-2: Tdetect,NR\_Inter\_enh, Tmeasure,NR\_Inter\_enh and Tevaluate,NR\_Inter\_enh**

|  |  |  |  |
| --- | --- | --- | --- |
| **DRX cycle length [s]** | **Tdetect,NR\_Inter\_enh [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter\_enh [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter\_enh [s] (number of DRX cycles)** |
|
| 0.32 | [3.2 x M2 (10 x M2)] Note 1 | [0.32 x M3 ([1] x M3)] Note 1 | 0.96 x M4 (3 x M4) Note 1 |
| 0.64 | [6.4 (10)] | [0.64 (1)] | 1.92 (3) |
| 1.28 | [10.24 (8)] | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: When SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2 |

If *t-Service* is broadcasted and applicable, UE shall be able to detect, measure, and evaluate neighbour cells before the serving cell stops serving the area regardless of whether the distance condition based on serving cell reference location or the legacy Srxlev/Squal condition are met, and when to start detection, measurement, and evaluation is up to UE implementation. This requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of the last updated value for t-Service is acquired by the UE for the first time to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Ttrigger, and Ttrigger = max(Tdetect,NR\_Intra, Kcarrier\* Tdetect,NR\_Inter) when serving cell is below the search threshold, and Ttrigger = max(Tdetect,NR\_Intra, Nlayer\* [60s]) when serving cell is above the search threshold, where

- Kcarrier is the number of NR inter-frequency carriers indicated by the serving cell,

- Nlayer is the total number of higher priority NR carrier frequencies broadcasted in system information,

- Tdetect,NR\_Intra refers to HST intra-frequency cell detection delay in IDLE/INACTIVE mode defined Table 4.2.2.3-2,

- Tdetect,NR\_Inter refers to HST inter-frequency cell detection delay in IDLE/INACTIVE mode defined Table 4.2.2.4-2.

The requriements in this clause apply provided that the number of SMTCs for any inter-frequency carrier does not exceed the [UE capability], otherwise UE may select one or subset of all the configured SMTCs sequentially until all of the SMTCs can be measured, the selection of SMTCs to be used is up to UE implementation, and longer measurement delay than the corresponding measurement period specified in Table 4.2C.2.4-1 and Table 4.2C.2.4-2 is expected.

The requirements in this clause apply provided that the valid information for the satellite serving the target cell has been provided by the serving cell.

The requirements in this clause apply provided that SSB of neighbour cells are within the time shifted SMTC.

4.2C.2.5 Maximum interruption in paging reception

UE shall perform the cell re-selection with minimum interruption in monitoring downlink channels for paging reception.

At intra-frequency and inter-frequency cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels of the target intra-frequency and inter-frequency cell for paging reception. The interruption time shall not exceed TSI-NR + K\*Ttarget\_cell\_SMTC\_period ms.

Where,

If the target cell belongs to the same satellite as the current one, and if the target cell is known, then K = 2.

If the target cell belongs to a different satellite than the current one and the target cell’s satellite is GEO, and if the target cell is known, then K = 2.

If the target cell belongs to a different satellite than the current one and the target cell’s satellite is non-GEO, then K = 5 if the target cell is known.

Ttarget\_cell\_SMTC\_period is the periodicity of the SMTC occasions configured for the target NR cell. If the target cell is in the PCI list of *smtc2-LP*, the SMTC periodicityfollows *smtc2-LP*; otherwise, the SMTC periodicity follows *smtc*.

TSI-NR is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for an NR cell.

The target cell is considered as known if it has been detectable during Tdetect,NR\_Intra or Tdetect,NR\_Inter, and the time span between SIB broadcasting cell stop time and the cell stop time is not less than Ttrigger. Otherwise, the target cell is considered as unknown, where Tdetect,NR\_Intra, Tdetect,NR\_Inter and Ttrigger are defined in 4.2C.2.3 and 4.2C.2.4. A longer interruption can be expected if the target cell is unknown.

These requirements assume sufficient radio conditions, so that decoding of system information can be made without errors and does not take into account cell re-selection failure.

4.2C.2.6 Minimum requirement at transitions

The requriements in clause 4.2.2.8 apply provided that target cell’s satellite is GEO.

4.2C.2.7 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2.2.9 apply provided that target cell’s satellite is GEO.

4.2C.2.8 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2.2.10 apply provided that target cell’s satellite is GEO.

4.2C.2.9 General requirements

The UE shall search every layer of higher priority at least every Thigher\_priority\_search = (60 \* Nlayers) seconds, where Nlayers is the total number of higher priority NR carrier frequencies broadcasted in system information.

4.2C.3 Requirements from NTN to TN

*Editor’s note:* Define requirements on NTN to TN cell reselection

UE is allowed to skip TN neighbour cells measurement in an area where there is no coverage of the frequency based on the provided TN cell coverage information and UE GNSS position information.

4.2C.4 Requirements from TN to NTN

*Editor’s note:* Define core requirements for GNSS ON and GNSS switch OFF to ON.

No specific value for the GNSS time to first fix to be define for the case of GNSS switch OFF to ON.

End of Change 1

Start of Change 2

## 5.1C Cell Re-selection for Satellite Access

### 5.1C.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it.

When the UE is in *Camped Normally* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency, inter-frequency cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may provide explicit neighbour list, or only carrier frequency information and bandwidth information. UE measurement activity is also controlled by measurement rules defined in TS38.304 [1], allowing the UE to limit its measurement activity.

The requirements in this clause shall apply for the quasi-earth\_fixed cell and the earth\_ moving cell.

### 5.1C.2 Requirements

#### 5.1C.2.1 UE measurement capability

The requirements in clause 4.2C.2.1 shall apply.

#### 5.1C.2.2 Measurement and evaluation of serving cell

The requirements in clause 4.2C.2.2 shall apply.

#### 5.1C.2.3 Measurements of intra-frequency NR cells

The requirements in clause 4.2C.2.3 shall apply. The requirements in clause 4.2C.2.7 apply for UE configured with relaxed measurement criterion.

#### 5.1C.2.4 Measurements of inter-frequency NR cells

The requirements in clause 4.2C.2.4 shall apply. The requirements in clause 4.2C.2.8 apply for UE configured with relaxed measurement criterion.

#### 5.1C.2.5 Maximum interruption in paging reception

The requirements in clause 4.2C.2.5 shall apply.

#### 5.1C.2.6 General requirements

The requirements in clause 4.2C.2.9 shall apply.

### 5.1C.3 Requirements from NTN to TN

*Editor’s note:* The requirements in clause 4.2C.3 shall apply.

### 5.1C.4 Requirements from TN to NTN

*Editor’s note:* The requirements in clause 4.2C.4 shall apply.

End of Change 2

Start of Change 3

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode".

[2] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[3] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[4] 3GPP TS 38.215: "NR; Physical layer measurements".

[5] 3GPP TS 38.533: "NR; User Equipment (UE) conformance specification; Radio Resource Management (RRM)".

[6] 3GPP TS 38.211: "NR; Physical channels and modulation”.

[7] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[8] 3GPP TS 38.212 "NR; Multiplexing and channel coding".

[9] 3GPP TS 38.202: "NR; Physical layer services provided by the physical layer".

[10] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[11] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[12] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".

[13] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

[14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[15] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[16] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".

[17] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.

[18] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[19] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[20] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[21] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

[22] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[23] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[24] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA); Overall description".

[25] 3GPP TS 36.101: "Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[26] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[27] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[28] Void.

[29] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[30] 3GPP TS 25.302: "Services provided by the Physical Layer".

[31] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA), Evolved Universal Terrestrial Radio Access (E-UTRA) and Next Generation Radio Access; Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

[32] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[33] 3GPP TS 37.213: "Physical layer procedures for shared spectrum channel access"

[34] 3GPP TS 37.355: "LTE Positioning Protocol (LPP) ".

[35] 3GPP TS 38.455 : "NG-RAN; NR Positioning Protocol A (NRPPa) ".

[36] 3GPP TS 37.106: “User Equipment (UE) requirements for shared spectrum channel access”.

[37] 3GPP TS 38.108: “NR; Satellite Access Node radio transmission and reception”.

End of Change 3

Start of Change 4

### 9.2C.7 Intra frequency measurements without measurement gaps for NTN band above 10GHz

#### 9.2C.7.1 Intra frequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index 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. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index.

 Tidentify\_intra\_without\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra) ms

 Tidentify\_intra\_with\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra) ms

Where:

 TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2C.7.1-1

 TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2C.7.1-2

 TSSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2C.7.2-1

 CSSFintra: it is a carrier specific scaling factor and is determined

 according to CSSFoutside\_gap,i in clause 9.1.5.1 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,i in clause 9.1.5.2 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*.

Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = Ntotal\_SAN / Navailable\_SAN, where Navailable\_SAN and Ntotal\_SAN are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where

- If UE is configured with concurrent measurement gaps, MGRP max is the maximum MGRP across all configured per-UE measurement gap. Otherwise, MGRP max is the MGRP of configured measurement gap.

- Ntotal\_SAN is the total number of SMTC occasions within the window, including those overlapped and non-overlapped with measurement gap occasions within the window, and

- Navailable\_SAN is the number of SMTC occasions within the window W that don’t collide with any non-dropped MG occasion within or outside the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1C.8.3. The collision rule between SMTC occasion and measurement gap occasion is defined in section 9.1C.9.1

Kp = [1] when Navailable\_SAN = 0 and measurement gap sharing in clause 9.1.2.1a shall apply.

Kp = 1 when intra-frequency SMTC is fully non overlapping with measurement gaps.

 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.*

Klayer1\_measurement: it is scaling factor for sharing between L3 and L1 measurement, and Klayer1\_measurement =1, if GEO satellites are measured on the carrier, or if LEO satellites are measured on the carrier and UE supports *parallelMeasurementWithoutRestriction*, otherwise

 Klayer1\_measurement =1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting 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 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, 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.

 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 or Tidentify\_intra\_with\_index

Table 9.2C.7.1-1: Time period for PSS/SSS detection

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil( 5 x Kp x Klayer1\_measurement) x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(5 x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| 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 9.2C.7.1-2: Time period for time index detection

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil( 3 x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(3 x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| 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 |

The requirements in clause 9.2C.7.1 and 9.2C.7.2 are not applicable when the overall overhead ratio due to scheduling restriction caused by all configured SMTCs (i.e. scheduling restriction overhead of all SMTCs in one SMTC periodicity), is larger than 75%.

#### 9.2C.7.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2C.7.2-1.

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

Table 9.2C.7.2-1: Measurement period for intra-frequency measurements without gaps

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra  |
| No DRX | max(200ms, ceil( 5 x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| 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 |

#### 9.2C.7.3 Scheduling availability of UE during intra-frequency measurements

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. For UL, the scheduling restriction applies to UL symbols that fully or partially overlap with the restricted symbols as defined below.

##### 9.2C.7.3.1 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on NTN bands above 10GHz

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.*

### 9.2C.8 Intra-frequency measurements with measurement gaps for NTN band above 10GHz

#### 9.2C.8.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index 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. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index.

 Tidentify\_intra\_without\_index = TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra ms

 Tidentify\_intra\_with\_index = TPSS/SSS\_sync\_ntra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra ms

Where:

 TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2C.8.2-1.

 TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2C.8.2-2.

 T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2C.8.3-1.

 Kgap is the scaling factor for a SSB frequency layer to be measured within an associated a measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. When the UE is configured with concurrent measurement gaps and the two measurement gaps are fully overlapping with MGRP=160ms, Kgap = 2. Otherwise, Kgap = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where

- If UE is configured with concurrent measurement gaps, MGRP max is the maximum MGRP across all configured per-UE measurement gap. Otherwise, MGRP max is the MGRP of configured measurement gap.

- Ntotal\_SAN is the total number of SMTC occasions within the window, including those overlapped and non-overlapped with measurement gap occasions within the window, and

- Navailable\_SAN is the number of SMTC occasions within the window W that don’t collide with any non-dropped MG occasion within or outside the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1C.8.3. The collision rule between SMTC occasion and measurement gap occasion is defined in section 9.1C.9.1

 CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within 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, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index.

Table 9.2C.8.2-1: Time period for PSS/SSS detection

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, 5 x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x 5) x Kgap x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | 5 x Kgap x max(MGRP, DRX cycle) x CSSFintra |

Table 9.2C.8.2-2: Time period for time index detection

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, 3 x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5 x 3) x Kgap x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | 3 x Kgap x max(MGRP, DRX cycle) x CSSFintra |

#### 9.2C.8.3 Intrafrequency Measurement Period

The measurement period for intrafrequency measurements with gaps is as shown in table 9.2C.8.3-1.

Table 9.2C.6.3-1: Measurement period for intra-frequency measurements with gaps

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra  |
| No DRX | max(200ms, 5 x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5) x Kgap x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | 5 x Kgap x max(MGRP, DRX cycle) x CSSFintra |

End of Change 4

Start of Change 5

### 9.3C.8 Inter-frequency measurement with measurement gaps for NTN band above 10GHz

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 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. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index.

 Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

 Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

 TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3C.8-1.

 TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3C.8-2.

 TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3C.9-1.

 CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1C.5.2 for measurement conducted within measurement gaps.

 Kgap is the scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. When the UE is configured with concurrent measurement gaps and the two measurement gaps are fully overlapping with MGRP=160ms, Kgap = 2. Otherwise, Kgap = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

 For a window W of duration max(SMTC period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gap, and starting from the beginning of any SMTC occasion:

- Ntotal is the total number of SMTC occasions that are covered by instances of the associated measurement gap within the window W, including those overlapped with other measurement gap occasions within the window, and

- Navailable is the number of SMTC occasions that are covered by instances of the non-dropped associated measurement gap within the window W after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3.

 Kgap is only applicable for UE supporting *parallelMeasurementGap-r17*. When concurrent measurement gaps are configured, requirements in this clause do not apply if Navailable =0, or if one SMTC overlaps more than one MGs associated to the frequency layer.

Table 9.3C.8-1: Time period for PSS/SSS detection

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter** |
| No DRX |  Max(600ms, Ceil(8 x Kgap) × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5 x Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 x Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. |

Table 9.3C.8-2: Time period for time index detection

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, Ceil(3 x Kgap) × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5 x Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(3 x Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. |

### 9.3C.9 Inter-frequency measurements for NTN band above 10GHz

When measurement gaps are provided for inter frequency measurements, or the UE supports capability of conducting such measurements without gaps, the 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 10.1C.4, 10.1C.5, 10.1C.9, 10.1C.10, 10.1C.14 and 10.1C.15, respectively, as shown in table 9.3C.5-1.

Table 9.3C.9-1: Measurement period for inter-frequency measurements with gaps

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, Ceil(8 x Kgap) × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5 x Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 x Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. |

### 9.3C.10 Inter frequency measurements without measurement gaps for NTN band above 10GHz

#### 9.3C.10.1 Inter frequency Cell identification

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index 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. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index.

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

 TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3C.10.1-1.

 TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3C.10.1-2.

 T SSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3C.10.2-1.

 CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1C.5.1 for measurement conducted outside measurement gaps, i.e. when inter-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps or according to CSSFwithin\_gap,i in clause 9.1C.5.2 for measurement conducted within measurement gaps, i.e. when inter-frequency SMTC is fully overlapping with measurement gaps.

Kp is the scaling factor for a SSB frequency layer to be measured without measurement gaps. Kp = Ntotal\_SAN / Navailable\_SAN, where Navailable\_SAN and Ntotal\_SAN are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where

- If UE is configured with concurrent measurement gaps, MGRP max is the maximum MGRP across all configured per-UE measurement gap. Otherwise, MGRP max is the MGRP of configured measurement gap.

- Ntotal\_SAN is the total number of SMTC occasions within the window, including those overlapped and non-overlapped with measurement gap occasions within the window, and

- Navailable\_SAN is the number of SMTC occasions within the window W that don’t collide with any non-dropped MG occasion within or outside the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1C.8.3. The collision rule between SMTC occasion and measurement gap occasion is defined in section 9.1C.9.1

Kp = [1] when Navailable\_SAN = 0 and measurement gap sharing in clause 9.1.2.1a shall apply.

Kp = 1 when inter-frequency SMTC is fully non overlapping with measurement gaps.

Table 9.3C.10.1-1: Time period for PSS/SSS detection

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter |
| NOTE 1: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. |

Table 9.3C.10.1-2: Time period for time index detection

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFinter |
| NOTE 1: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. |

#### 9.3C.10.2 Measurement period

The 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 10.1C.4, 10.1C.5, 10.1C.9, 10.1C.10, 10.1C.14 and 10.1C.15, respectively, as shown in table 9.3C.7.2-1, if UE supports inter-frequency measurement without measurement gaps:

Table 9.3C.10.2-1: Measurement period for inter-frequency measurements without gaps

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter  |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter |
| NOTE 1: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. |

#### 9.3C.10.3 Scheduling availability of UE during inter-frequency measurements

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE is required to 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 to be measured in the following clauses are the SSB symbols indicated by SSB-ToMeasure [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. For UL, the scheduling restriction applies to UL symbols that fully or partially overlap with the restricted symbols as defined below.

##### 9.3C.10.3.1 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on NTN bands above 10GHz

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-Inter-r16* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If UE performs inter-frequency measurements without measurement gaps in a TDD band, 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 UE performs inter-frequency measurements without measurement gaps in a FDD band, 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.

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

End of Change 5

Start of Change 6

### 9.5C.7 L1-RSRP measurement requirements for NTN band above 10GHz

#### 9.5C.7.1 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\_SAN.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_SAN is defined in Table 9.5C.7.1-1, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- P value for SSB resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any SSB resource occasion:

- Ntotal is the total number of SSB resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of SSB resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of SSB resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target SSB.

- Psharing factor = 3.

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

Table 9.5C.7.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_SAN

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_SAN (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. |

9.5C.7.2 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\_SAN.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS is defined in Table 9.5C.7.2-1, 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

- P value for a CSI-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any CSI-RS resource occasion:

- Ntotal is the total number of CSI-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of SSB resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target CSI-RS.

- Psharing factor = 3.

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.

Table 9.5C.7.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN (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. |

### 9.5C.8 Measurement restriction for L1-RSRP measurement for NTN band above 10GHz

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.

#### 9.5C.8.1 Measurement restriction for SSB based L1-RSRP

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.

#### 9.5C.8.2 Measurement restriction for CSI-RS based L1-RSRP

For NTN bands above 10GHz, 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 NTN bands above 10GHz, 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 NTN bands above 10GHz, 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 NTN bands above 10GHz, 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.

### 9.5C.9 Scheduling availability of UE during L1-RSRP measurement for NTN band above 10GHz

Scheduling availability restrictions when the UE is performing L1-RSRP measurement are described in the following clauses. For UL, the scheduling restriction applies to UL symbols that fully or partially overlap with the restricted symbols as defined below.

#### 9.5C.9.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on NTN bands above 10GHz

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.

#### 9.5C.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on NTN bands above 10GHz

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.

- 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.

End of Change 6

Start of Change 7

## 7.1C UE transmit timing for Satellite Access

### 7.1C.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 $\left(N\_{TA}+N\_{TA-offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)×T\_{c}$ 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.

### 7.1C.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te\_NTN where the timing error limit value Te\_NTN.

Te\_NTN is specified in Table 7.1C.2-1 for FR1.

Te\_NTN is specified in Table 7.1C.2-2 and Table 7.1C.2-3 for VSAT UE in FR2-NTN.

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\_NTN requirement for an initial transmission provided that at least one 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 $\left(N\_{TA}+N\_{TA-offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)×T\_{c}$.

The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at the UE antenna.

*N*TA for PRACH is defined as 0. $\left(N\_{TA}+N\_{TA-offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)×T\_{c}$ (in *T*c units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3 was applied. or after the last update in $N\_{TA,adj}^{common}$ or $N\_{TA,adj}^{UE}$.

The value of *N*TA-offset depends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). *N*TA-offset is defined in Table 7.1.2-2.

$N\_{TA,adj}^{common}$ and $N\_{TA,adj}^{UE}$ are as defined in TS38.211 [6].

Table 7.1C.2-1: Te\_NTN Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te\_NTN |
| 1 | 15 | 15 | 29\*64\*Tc |
|  |  | 30 | 24\*64\*Tc |
|  |  | 60 | N/A |
|  | 30 | 15 | 24\*64\*Tc |
|  |  | 30 | 22\*64\*Tc |
|  |  | 60 | N/A |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] |

Table 7.1C.2-2: Te\_NTN Timing Error Limit for fixed VSAT is served by GSO and fixed VSAT is served by NGSO

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te\_NTN |
| FR2-NTN | 120 | 60 | 13\*64\*Tc |
| 120 | 7.5\*64\*Tc |
| 240 | 60 | 13\*64\*Tc |
| 120 | 7.5\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] |

Editor’s Note: FFS on the applicable side condition for fixed VSAT is served by NGSO

Table 7.1C.2-3: Te\_NTN Timing Error Limit for mobile VSAT is served by GSO

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te\_NTN |
| FR2-NTN | 120 | 60 | 13\*64\*Tc |
| 120 | [Higher value than 7.5]\* 64\*Tc |
| 240 | 60 | 13\*64\*Tc |
| 120 | [Higher value than 7.5]\* 64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] |

Editor’s Note: FFS on the definition or how to differentiate fixed VST and mobile VSAT

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, the updating of $N\_{TA,adj}^{common}$ and the updating of $N\_{TA,adj}^{UE}$, except when the timing advance in clause 7.3C is applied.

#### 7.1C.2.1 Gradual timing adjustment

When the transmission timing error between the UE and the reference timing exceeds ±Te\_NTN then the UE is required to adjust its timing to within ±Te\_NTN. The reference timing shall be $\left(N\_{TA}+N\_{TA-offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)×T\_{c}$ 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, apart from a change of $N\_{TA,adj}^{UE}$ due to satellite position update and $N\_{TA,adj}^{common}$ between the previous transmission and the current transmission, in one adjustment shall be Tq\_NTN.

2) The minimum aggregate adjustment rate, apart from a change of $N\_{TA,adj}^{UE}$ due to satellite position update and $N\_{TA,adj}^{common}$ during the last one second, shall be Tp\_NTN per second.

3) The maximum aggregate adjustment rate, apart from a change of $N\_{TA,adj}^{UE}$ due to satellite position update and $N\_{TA,adj}^{common}$ during the last 200ms, shall be Tq\_NTN per 200 ms.

Where, the maximum autonomous time adjustment step Tq\_NTN and the aggregate adjustment rate Tp\_NTN are specified in Table 7.1C.2.1-1.

**Table 7.1C.2.1-1: Tq\_NTN Maximum Autonomous Time Adjustment Step and Tp\_NTN Minimum Aggregate Adjustment rate**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency Range** | **SCS of uplink signals (kHz)** | **Tq\_NTN** | **Tp\_NTN** |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | N/A | N/A |
| [FR2-NTN] | 60 | 2.5\*Tc | 2.5\*64\*Tc |
| 120 | 2.5\*Tc | 2.5\*64\*Tc |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [6] |

End of Change 7

Start of Change 8

## 7.2C UE timer accuracy for satellite access

### 7.2C.1 Introduction

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

### 7.2C.2 Requirements

The requirements in this clause are applicable for both UE served by SAN in FR1 and VSAT UE served by SAN in FR2-NTN.

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

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

End of Change 8

Start of Change 9

## 7.3C Timing advance for satellite access

### 7.3C.1 Introduction

The timing advance is initiated by UE configured with only PCell served by SAN, upon initiating a validity timer for $N\_{TA,adj}^{common}$and $N\_{TA,adj}^{UE}$. The timing advance can be adjusted with MAC message that implies the adjustment of the timing advance, as defined in clause 5.2 of TS 38.321 [7].

### 7.3C.2 Requirements

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

UE shall adjust the timing of its uplink transmission timing from the beginning of uplink time slot *n*+ *k+1+2µ* $∙K\_{offset}$ for a timing advance command received in time slot *n*, and the value of *k, µ* and $K\_{offset}$ are 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.

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

The UE shall adjust the timing of its transmissions, apart from a change of $N\_{TA,adj}^{UE}$ and $N\_{TA,adj}^{common}$ between the preceding uplink transmission and the current transmission, with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.3C.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 7.3C.2.2-1: UE Timing Advance adjustment accuracy

|  |  |  |  |
| --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | N/A |

Table 7.3C.2.2-2: UE Timing Advance adjustment accuracy for VSAT UE in FR2-NTN

|  |  |  |
| --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 60 | 120 |
| UE Timing Advance adjustment accuracy | 128 Tc | 32 Tc |
| NOTE 1: VSAT UE are defined in TS 38.xxx |

*Editor’s Note: it would be further clarified with the additional conditions for TA adjustment accuracy requirement for satellite access*

End of Change 9

Start of Change 10

#### 6.1C.1.3 NR SAN FR2-NTN – NR SAN FR2-NTN Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR SAN FR2-NTN cell to NR SAN FR2-NTN cell. The requirements in this clause apply provided that UE has the valid and applicable parameters of ephemeris information, common TA, DL and UL Polarization information, Koffset, and Kmac for target NR SAN cell during Dhandover, otherwise interruption time may be longer than the requirements in clause 6.1C.1.3.2.

##### 6.1C.1.3.1 Handover delay

When the UE receives a RRC message implying handover to NR SAN cell, the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover msec from the end of the last TTI containing the RRC command.

Where:

- Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1C.1.3.2.

##### 6.1C.1.3.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover to NR SAN cell is commanded, and if the target NR SAN cell is served by the same satellite as the serving cell, the interruption time shall be less than Tinterrupt\_intra\_sat, where Tinterrupt\_intra\_sat is same as Tinterrupt defined in clause 6.1C.1.2.2.

When intra-frequency or inter-frequency handover to NR SAN cell is commanded, and if the target NR SAN cell is served by a differnt satellite than the serving cell, the interruption time shall be less than Tinterrupt\_inter\_sat, where

 Tinterrupt\_inter\_sat = Tsearch + TIU + Tprocessing + Tsat\_beam + T∆ + Tmargin ms

Where:

- Tsearch is the time required to search the target NR SAN cell. If the target cell is an intra-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = Trs ms. If the target cell is an inter-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = 3\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs.

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

- Tsat\_beam is additional time for UE to steer the downlink spatial domain reception filter to the target cell.

- For UE indicating [Type 1] via UE capability [TBD], Tsat\_beam is 3\*Trs

- For UE indicating [Type 2] via UE capability [TBD], Tsat\_beam is Oangle / 22.5 s, where Oangle is the angle offset observated from UE in degree between the satellite for the serving cell and the satellite for the target cell.

- Trs is the SMTC periodicity of the target NR SAN cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

End of Change 10

Start of Change 11

#### 6.1C.2.3 NR SAN NTN-FR2 – NR SAN NTN-FR2 conditional handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency conditional handover from NR SAN NTN-FR2 cell to NR SAN NTN-FR2 cell, when the serving cell and the target cell are served by the same satellite.

The requirements in this clause apply provided that UE has the valid and applicable parameters of ephemeris information, common TA, DL and UL Polarization information, Koffset, and Kmac for target NR SAN cell during DCHO, otherwise the measurement time, preparation time and interruption time may be longer than the requirements in clause 6.1C.2.2.2, 6.1C.2.2.3 and 6.1C.2.2.4.

The requirements in this clause 6.1C.2.2 shall apply.

End of Change 11

Start of Change 12

##### 6.2C.1.2.2 UE Re-establishment delay requirement for VSAT

The requirements in this clause are applicable to both intra-frequency and inter-frequency RRC Re-establishment.

The requirements in clause 6.2C.1.2.1 shall apply, provided that the serving cell and the target cell are served by the same satellite, and UE is not configured to measure a different satellite for RRC Re-establishment.

End of Change 12

Start of Change 13

8.1C Radio Link Monitoring for Satellite Access

8.1C.1 Introduction

The requirements in clause 8.1C apply for radio link monitoring on PCell and the UE is configured with only PCell, which is served by satellite access node (SAN).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 and Qin for the purpose of monitoring downlink radio link quality of the cell.

The threshold Qout 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 8.1C.1-1. For SSB based radio link monitoring, Qout\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1C.2.1-1. For CSI-RS based radio link monitoring, Qout\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1C.3.1-1.

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

The out-of-sync block error rate (BLERout) and in-sync block error rate (BLERin) 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 8.1C.1-1 by default. All requirements in clause 8.1C are applicable for BLER Configuration #0 in Table 8.1C.1-1.

**Table 8.1C.1-1: Out-of-sync and in-sync block error rates**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **BLERout** | **BLERin** |
| 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 8.1C.1-2 according TS 38.213 [3], and meet the requirements as specified in clause 8.1C. UE is not required to meet the requirements in clause 8.1C if RLM-RS is not configured and no TCI state for PDCCH is activated.

**Table 8.1C.1-2: Maximum number of RLM-RS resources NRLM**

|  |  |  |
| --- | --- | --- |
| **Carrier frequency range of PCell**  |  | **Maximum number of RLM-RS resources, NRLM**  |
| FR1, ≤ 3 GHzNote  | 4 | 2 |
| FR1, > 3 GHzNote  | 8 | 4 |
| [FR2-NTN]Note 2 | 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].NOTE 2: [NTN bands within this frequency range are regarded as a FR2 band when references from other specifications.] |

8.1C.2 Requirements for SSB based radio link monitoring

8.1C.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 8.1C.2.2.

**Table 8.1C.2.1-1: PDCCH transmission parameters for out-of-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| 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) | 24 |
| 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 |

**Table 8.1C.2.1-2: PDCCH transmission parameters for in-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| 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) | 24 |
| 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 |

8.1C.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 [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB [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 [ms] period becomes better than the threshold Qin\_SSB within TEvaluate\_in\_SSB [ms] evaluation period.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1C.2.2-1 and Table 8.1C.2.2-1 for FR1 and [FR2-NTN], respectively.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

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 an FR1 and [FR2-NTN] serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

**Table 8.1C.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_SSB (ms)**  | **TEvaluate\_in\_SSB (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 8.1C.2.2-2: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for [FR2-NTN]**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_SSB (ms)**  | **TEvaluate\_in\_SSB (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. |

8.1C.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 and [FR2-NTN], 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.

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

8.1C.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 8.1C.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 8.1C.3.1-1: PDCCH transmission parameters for out-of-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| 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 |

**Table 8.1C.3.1-2: PDCCH transmission parameters for in-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| 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 |

8.1C.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 ms period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS 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 ms period becomes better than the threshold Qin\_CSI-RS within TEvaluate\_in\_CSI-RS ms evaluation period.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1C.3.2-1 for FR1.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1C.3.2-2 for [FR2-NTN].

The requirements of TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS 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.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

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 an FR1 and [FR2-NTN] serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

The values of Mout and Min used in Table 8.1C.3.2-1 are defined as:

- Mout = 20 and Min = 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 8.1C.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)**  | **TEvaluate\_in\_CSI-RS (ms)**  |
| no DRX | Max(200, Ceil(Mout×P)×TCSI-RS) | Max(100, Ceil(Min×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout×P) × TDRX | Ceil(Min×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 8.1C.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for [FR2-NTN]**

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

8.1C.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 FR1 and [FR2-NTN], 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 and [FR2-NTN], 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 and [FR2-NTN], 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 and [FR2-NTN], 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.

8.1C.4 Minimum requirement at transitions

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each RLM-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 RLM-RS resource. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of RLM resources to a second configuration of RLM resources that is different from the first configuration, for each RLM 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 RLM resource present in the second configuration. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

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 RLM present in the second configuration, the UE shall use an evaluation period corresponding to the second configuration from the time of transition. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

8.1C.5 Minimum requirement for UE turning off the transmitter

The transmitter power of the UE in the monitored cell shall be turned off within 40ms after expiry of T310 timer as specified in TS 38.331 [2].

8.1C.6 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout, 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, 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.

When DRX is not used TIndication\_interval 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 8.1C.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 8.1C.3 if the RLM-RS resource is CSI-RS.

In case DRX is used, TIndication\_interval 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.

8.1C.7 Scheduling availability of UE during radio link monitoring

When the reference signal to be measured for RLM has different subcarrier spacing than PDSCH/PDCCH , there are restrictions on the scheduling availability as described in the following clauses.

8.1C.7.1 Scheduling availability of UE performing radio link monitoring with a same subcarrier spacing as PDSCH/PDCCH on FR1 and [FR2-NTN]

There are no scheduling restrictions due to radio link monitoring performed with a same subcarrier spacing as PDSCH/PDCCH on FR1 and [FR2-NTN].

8.1C.7.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1 and [FR2-NTN]

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.

End of Change 13

Start of Change 14

#### 6.1C.1.2 NR SAN FR1 – NR SAN FR1 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR SAN FR1 cell to NR SAN FR1 cell. The requirements in this clause apply provided that UE has the valid and applicable parameters of ephemeris information, common TA, DL and UL Polarization information, Koffset, and Kmac for target NR SAN cell during Dhandover, otherwise interruption time may be longer than the requirements in clause 6.1C.1.2.2.1 or clause 6.1C.1.2.2.2.

##### 6.1C.1.2.1 Handover delay

When the UE receives a RRC message implying handover to NR SAN cell, the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover msec from the end of the last TTI containing the RRC command when UE is configured with RACH-based handover.

When the UE receives a RRC message implying handover to NR SAN cell, the UE shall be ready to start the transmission of the new uplink PUSCH channel or SR on PUCCH channel within Dhandover msec from the end of the last TTI containing the RRC command when UE is configured with RACH-less handover.

Where:

- Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1C.1.2.2.1 when UE is configured with RACH-based handover.

- Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1C.1.2.2.2 when UE is configured with RACH-less handover.

##### 6.1C.1.2.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

##### 6.1C.1.2.2.1 Interruption time for RACH-based handover

When intra-frequency or inter-frequency handover to NR SAN cell is commanded,

the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Otherwise, no interruption time requirement is applied.

Where:

- Tsearch is the time required to search the target NR SAN 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 = Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = 3\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs.

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

- Trs is the SMTC periodicity of the target NR SAN cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

##### 6.1C.1.2.2.2 Interruption time for RACH-less handover

When intra-frequency or inter-frequency RACH-less handover to NR SAN cell is commanded,

the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Otherwise, no interruption time requirement is applied.

Where:

- Tsearch is same as the one defined in section 6.1C.1.2.2.1.

- T∆ is is same as the one defined in section 6.1C.1.2.2.1.

- Tprocessing is same as the one defined in section 6.1C.1.2.2.1.

- Tmargin is same as the one defined in section 6.1C.1.2.2.1.

- TIU is the interruption uncertainty in acquiring the first UL transmission resource, which can be a configured grant based PUSCH, dynamic grant based PUSCH, SR on PUCCH, according to NW configuration and scheduling. [TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].]

End of Change 14

Start of Change 15

##### 6.1C.2.2.4 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the measurment time shall be less than

 Tinterrupt = Tprocessing + TIU + T∆ + Tmargin ms

Where:

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3]. [For combination of RACH-less handover with time-based conditional handover, TIU can be a configured grant based PUSCH, dynamic grant based PUSCH, SR on PUCCH, according to NW configuration and scheduling, or PRACH if no SSB mapping to pre-allocated grant has RSRP above the threshold while T304 is running.]

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. TΔ = Trs.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- Trs is the SMTC periodicity of the target NR SAN cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell [for RACH-based conditional handover.]

End of Change 15

Start of Change 16

### 6.1C.3 NR SAN Satellite switching without PCI change

#### 6.1C.3.1 Introduction

The purpose of NR SAN Satellite switching without PCI change is to switch satellite in the same SSB frequency and same gNB without PCI changing. The requirements in this clause are applicable to SA NR SAN.

#### 6.1C.3.2 NR SAN FR1 – NR SAN FR1 Satellite switching without PCI change

The requirements in this clause are applicable to both hard and soft switch over in quasi-earth fixed scenario from NR SAN FR1 cell to NR SAN FR1 cell. The requirements in this clause apply provided that UE has the valid and applicable parameters of ephemeris information, common TA, DL and UL Polarization information, Koffset, and Kmac for target NR SAN cell during Dswitch\_unchangedPCI, otherwise interruption time may be longer than the requirements in clause 6.1C.3.2.2.

##### 6.1C.3.2.1 Satellite switching delay

When the UE receives a broadcast message implying switch to NR SAN cell without PCI change and starts synchronizing with target satellite, the UE shall be ready to start the transmission of the new uplink PRACH channel [or transmission of the new uplink excepting PRACH channel] within Dswitch\_unchangedPCI msec.

Where:

- Dswitch\_unchangedPCI equals the interruption time stated in clause 6.1C.3.2.2.

##### 6.1C.3.2.2 Interruption time for hard satellite switch

The interruption time is the time between [*T-start*] and the time the UE starts transmission of the new PRACH for the switch is PRACH transmission for PRACH-based case [or first UL transmission excepting PRACH for without RACH performed solution]

When intra-frequency hard switch to NR SAN cell is commanded,

the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Otherwise, no interruption time requirement is applied.

Where:

- Tsearch is the time required to search the target NR SAN cell when the target cell is not already known when UE starts synchronizing with target satellite. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = [Trs] ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs.

- Tprocessing is time for UE processing. Tprocessing can be up to [5] ms.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

- [Trs is the SMTC periodicity of the source NR SAN cell, otherwise] Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. [If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms]. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

##### 6.1C.3.2.3 Interruption time for soft satellite switch

Editor notes: FFS on the requirements on soft satellite switch

End of Change 16

Start of Change 17

#### 6.1C.2.3 NR SAN FR1 – NR SAN FR1 conditional handover without L3 measurement criteria

The requirements in this clause are applicable to both intra-frequency and inter-frequency conditional handover from NR SAN FR1 cell to NR SAN FR1 cell without L3 measurement criteria. The requirements in this clause apply provided that UE has the valid and applicable parameters of ephemeris information, common TA, DL and UL Polarization information, Koffset, and Kmac for target NR SAN cell during DCHO, otherwise preparation time and interruption time may be longer than the requirements in clause 6.1C.2.3.2, 6.1C.2.3.3 and 6.1C.2.3.4.

##### 6.1C.2.3.1 Handover delay

Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2]. UE is allowed to execute time-based and location-based conditional handover without RRM measurement once the time or distance condition is met, the time/distance condition is defined in clause 5.5.4 in TS 38.331[2]

When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel within DCHO seconds from the end of the last TTI containing the RRC command.

 DCHO = TRRC + TEvent\_DU + Tinterrupt + TCHO\_execution

Where:

- TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

For time-based conditional handover:

- TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until condition T1-1 is fulfilled which will trigger the conditional handover

For location-based conditional handover:

- TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until both condition D1-1 and condition D1-2 are fulfilled which will trigger the conditional handover

- TCHO\_execution is the UE conditional execution preparation time for conditional handover in clause 6.1C.2.3.2.

- Tinterrupt is the interruption time stated in clause 6.1C.2.3.3.

##### 6.1C.2.3.2 Preparation time

TCHO\_execution is the UE execution preparation time for conditional handover, and starts after UE realizes the condition of CHO is met and identity of the target cell is determined. TCHO\_execution can be up to 10ms.

##### 6.1C.2.3.3 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional handover, the measurment time shall be less than

 Tinterrupt = Tprocessing + Tsearch + TIU + T∆ + Tmargin ms

Where:

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- Tsearch is the time required to search the target cell when the target cell is not already known when the conditional 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 = Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = 3\* Trs ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3]. For combination of RACH-less handover with time-based conditional handover, TIU can be a configured grant based PUSCH, dynamic grant based PUSCH, SR on PUCCH, according to NW configuration and scheduling, or PRACH if no SSB mapping to pre-allocated grant has RSRP above the threshold while T304 is running.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. TΔ = Trs.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- Trs is the SMTC periodicity of the target NR SAN cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell for RACH-based conditional handover.

End of Change 17