# 9 Measurement Procedure

## 9.1 General measurement requirement

### 9.1.1 Introduction

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

In the requirements of clause 9, the exceptions for side conditions apply as follows:

- for the UE capable of CA but not configured with any SCell, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.1 for UE supporting CA in FR1, and clause B.3.2.3 for UE supporting CA in FR2, respectively;

- for the UE capable of CA and configured with at least one SCell, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.2 for UE configured with CA in FR1, and clause B.3.2.4 for UE supporting CA in FR2, respectively;

- for the UE capable of SUL but not configured with SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.1 for UE supporting SUL in FR1;

- for the UE capable of SUL and configured with at least one SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.2 for UE configured with SUL in FR1.

### 9.1.2 Measurement gap

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

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

If the UE is configured via LPP [34] to measure PRS for any RSTD, PRS-RSRP, UE Rx-Tx time difference measurement and PRS-RSRPP measurement defined in TS 38.215 [4], in order for the requirements in clauses 9.9.2, 9.9.3, 9.9.4 and 9.9.6 to apply, the network must provide

- a single per-UE measurement gap pattern for concurrent monitoring of all positioning frequency layers and intra-frequency, inter-frequency and/or inter-RAT frequency layers of all frequency ranges, or

- for measurement gap patterns other than #24 and #25, if UE supports independent measurement gap patterns for different frequency ranges for PRS measurement, per-FR measurement gap pattern for the frequency range for concurrent monitoring of all positioning frequency layers and intra-frequency, inter-frequency cells and/or inter-RAT frequency layers in the corresponding frequency range.

During the per-UE measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding E-UTRAN PCell, E-UTRAN SCell(s) and NR serving cells for E-UTRA-NR dual connectivity except the reception of signals used for RRM measurement(s) and the signals used for random access procedure according to TS38.321 [7].

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

- is not required to conduct reception/transmission from/to the corresponding PCell, SCell(s) and E-UTRAN serving cells for NR-E-UTRA dual connectivity except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to [7].

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

During the per-FR measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding E-UTRAN PCell, E-UTRAN SCell(s) and NR serving cells in the corresponding frequency range for E-UTRA-NR dual connectivity except the reception of signals used for RRM measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding NR serving cells in the corresponding frequency range for SA (with single carrier or CA configured) except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding PCell, SCell(s) and E-UTRAN serving cells in the corresponding frequency range for NR-E-UTRA dual connectivity except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding NR serving cells in the corresponding frequency range for NR-DC except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to TS38.321 [7].

UEs shall support the measurement gap patterns listed in Table 9.1.2-1 based on the applicability specified in table 9.1.2-2 and 9.1.2-3. UE determines measurement gap timing based on gap offset configuration and measurement gap timing advance configuration provided by higher layer signalling as specified in TS 38.331 [2] and TS 36.331 [16].

Table 9.1.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 5.5 | 20 |
| 13 | 5.5 | 40 |
| 14 | 5.5 | 80 |
| 15 | 5.5 | 160 |
| 16 | 3.5 | 20 |
| 17 | 3.5 | 40 |
| 18 | 3.5 | 80 |
| 19 | 3.5 | 160 |
| 20 | 1.5 | 20 |
| 21 | 1.5 | 40 |
| 22 | 1.5 | 80 |
| 23 | 1.5 | 160 |
| 24 | 10 | 80 |
| 25 | 20 | 160 |

Table 9.1.2-2: Applicability for Gap Pattern Configurations supported by the E-UTRA-NR dual connectivity UE or NR-E-UTRA dual connectivity UE

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement PurposeNote 5 | Applicable Gap Pattern Id |
| Per-UE | E-UTRA + FR1, or | non-NR RAT Note1,2 | 0,1,2,3 |
| Measurement gap | E-UTRA + FR2, or E-UTRA + FR1 + FR2 | FR1 and/or FR2 Note 7 | 0-11, 24, 25 |
|  |  | non-NR RATNote1,2 and FR1 and/or FR2 Note 7 | 0, 1, 2, 3, 4, 6, 7, 8,10, 24 |
|  | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 | 0,1,2,3 |
|  | FR2 if configured |  | No gap |
|  | E-UTRA and, FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | E-UTRA and, FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement gap | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 and FR1 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured |  | No gap |
|  | E-UTRA and, FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 and FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured |  | 12-23 |
|  | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 and FR1 and FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured |  | 12-23 |
| Note: In E-UTRA-NR dual connectivity mode, if GSM or UTRA TDD or UTRA FDD inter-RAT frequency layer is configured to be monitored, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap. In NR-E-UTRA dual connectivity mode, if UTRA FDD inter-RAT frequency layer is configured to be monitored for SRVCC, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap.  NOTE 1: In E-UTRA-NR dual connectivity mode, non-NR RAT includes E-UTRA, UTRA and/or GSM. In NR-E-UTRA dual connectivity mode, non-NR RAT means E-UTRA, and UTRA for SRVCC.  NOTE 2: Void  NOTE 3: When E-UTRA inter-frequency RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern #0 can be used.  NOTE 4: For UE supporting *supportedGapPattern-NRonly-NEDC* or *measGapPatterns-NRonly-ENDC-r16* but not supporting *supportedGapPattern* for the corresponding gap patterns among GP2-11, the corresponding gap patterns are not applicable to measurement of non-NR RATs as defined in NOTE 1.  NOTE 5: Inclusion of positioning measurements: Measurement purpose which includes E-UTRA measurements includes also E-UTRA RSRP and E-UTRA RSRQ measurements for E-CID.  NOTE 6: Measurement gap patterns #24 and #25 can be requested [2] only when the UE is configured at least with any of RSTD, UE Rx-Tx, or PRS-RSRP measurements requiring such gaps and can only be used during the corresponding positioning measurement period  NOTE 7: Inclusion of positioning measurements for measurement gaps: Measurement purpose which includes any of FR1 and FR2 measurements includes also RSTD, UE Rx-Tx, and PRS-RSRP measurements. | | | |

In E-UTRA-NR dual connectivity mode,

- if per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest E-UTRA subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest E-UTRA subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among SCG serving cells subframes in FR2.

In NR-E-UTRA dual connectivity mode,

- if per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE has NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among MCG serving cells subframes in FR1.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE doesn’t have NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest E-UTRA subframe occurring immediately before the configured measurement gap among SCG serving cells subframes.

- if per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among MCG serving cells subframes in FR2.

In NR-NR dual connectivity mode,

- If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest MCG subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest MCG subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest SCG subframe occurring immediately before the configured measurement gap among SCG serving cells subframes in FR2.

TMG is the MG timing advance value provided in *mgta* according to TS38.331 [2].

In determining the measurement gap starting point, UE shall use the DL timing of the latest E-UTRA or NR subframe occurring immediately before the configured measurement gap among E-UTRA or NR serving cells.

For per-FR measurement gap capable UE configured with E-UTRA-NR dual connectivity or NR-E-UTRA dual connectivity, when serving cells are in E-UTRA and FR1, measurement objects are in both E-UTRA/FR1 and FR2,

- If MN indicates UE that the measurement gap from MN applies to E-UTRA/FR1/FR2 serving cells, UE fulfils the per-UE measurement requirements for both E-UTRA/FR1 and FR2 measurement objects based on the measurement gap pattern configured by MN;

- If MN indicates UE that the measurement gap from MN applies to only LTE/FR1 serving cell(s),

- UE fulfils the measurement requirements for FR1/LTE measurement objects based on the configured measurement gap pattern;

- UE fulfils the requirements for FR2 measurement objects based on effective MGRP=20ms;

For per-FR measurement gap capable configured with E-UTRA-NR dual connectivity, NR-E-UTRA dual connectivity or NR-NR dual connectivity, when serving cells are in E-UTRA, FR1 and FR2, or in E-UTRA and FR2, or in FR1 and FR2, measurement objects are in both E-UTRA /FR1 and FR2,

- If MN indicates UE that the measurement gap from MN applies to E-UTRA/FR1/FR2 serving cells, UE fulfils the per-UE measurement requirements for both E-UTRA/FR1 and FR2 measurement objects based on the measurement gap pattern configured by MN.

Table 9.1.2-3: Applicability for Gap Pattern Configurations supported by the UE with NR standalone operation (with single carrier, NR CA and NR-DC configuration)

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement Purpose NOTE 2 | Applicable Gap Pattern Id |
|  | FR1 NOTE5, or  FR1 + FR2 | non-NR RAT NOTE3,6 | 0,1,2,3 |
|  |  | FR1 and/or FR2 NOTE 9 | 0-11, 24, 25 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE3,6,9 | 0, 1, 2, 3, 4, 6, 7, 8,10, 24 |
| Per-UE measurement | FR2 NOTE5 | non-NR RATonly  NOTE3,6 | 0,1,2,3 |
| gap |  | FR1 only NOTE 9 | 0-11, 24, 25 |
|  |  | FR1 and FR2 NOTE 9 | 0-11, 24, 25 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE3,6,9 | 0, 1, 2, 3, 4, 6, 7, 8,10, 24 |
|  |  | FR2 only NOTE 9 | 12-23 |
|  | FR1 if configured | non-NR RATonly | 0,1,2,3 |
|  | FR2 if configured | NOTE3,6 | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| gap | FR2 if configured | FR1 NOTE3,6 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 NOTE3,6 | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR1 and FR2 NOTE3,6 | 12-23 |
| NOTE 1: When E-UTRA inter-RAT RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern #0 can be used.  NOTE 2: Measurement purpose which includes E-UTRA measurements includes also inter-RAT E-UTRA RSRP and RSRQ measurements for E-CID; measurement purpose which includes E-UTRA measurements includes also E-UTRA RSRP and E-UTRA RSRQ measurements for E-CID.  NOTE 3: Void  NOTE4: If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among all serving cells subframes.  If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR1.  If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the measurement gap starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured measurement gap among serving cells.  NOTE 5: NR-DC in Rel-15 only includes the scenarios where all serving cells in MCG in FR1 and all serving cells in SCG in FR2.  NOTE 6: In NR single carrier, NR CA, and NR-DC mode, non-NR RAT means E-UTRA, and UTRA for SRVCC. In NR single carrier, NR CA, and NR-DC mode, if UTRA FDD inter-RAT frequency layer is configured to be monitored for SRVCC, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap.  NOTE 7: For UE only supporting *supportedGapPattern-NRonly* for any gap patterns among GP2-11, the corresponding gap patterns are not applicable to measurement of non-NR RATs as defined in NOTE 6.  NOTE 8: Measurement gap patterns #24 and #25 can be requested [2] only when the UE is configured with any of RSTD, UE Rx-Tx, or PRS-RSRP measurements requiring such gaps and can only be used during the corresponding positioning measurement period.  NOTE 9: Inclusion of positioning measurements for measurement gaps: Measurement purpose which includes any of FR1 and FR2 measurements includes also RSTD, UE Rx-Tx, and PRS-RSRP measurements. | | | |

For per-FR measurement gap capable UE in NR standalone operation (with single carrier, NR CA and NR-DC configuration), for per-FR gap based measurement, when there is no serving cell in a particular FR, where measurement objects are configured, regardless if explicit per-FR measurement gap is configured in this FR, the effective MGRP in this FR is used to determine requirements;

- 20 ms for FR2 NR measurements

- 40 ms for FR1 NR measurements

- 40 ms for LTE measurements

- 40 ms for FR1+LTE measurements

For per-FR measurement gap capable UE in NR standalone operation (with single carrier, NR CA and NR-DC configuration), when serving cells are in FR1 or FR2, measurement objects are in both E-UTRA /FR1 and FR2,

- If MN indicates UE that the measurement gap from MN applies to E-UTRA/FR1/FR2 serving cells, UE fulfils the per-UE measurement requirements for both E-UTRA/FR1 and FR2 measurement objects based on the measurement gap pattern configured by MN;

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

For single carrier or CA with aligned frame boundaries,

For E-UTRA-NR dual connectivity (with NR single carrier, NR CA configuration), if UE is not capable of per-FR-gap, total interruption time on SCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms and 3ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cells in SCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms and 3ms, and total interruption time on FR2 serving cells in SCG during MGL is defined only when MGL(N) = 20ms, 10ms, 5.5ms, 3.5ms and 1.5ms.

For NR standalone operation (with single carrier, NR CA and NR-DC configuration), if UE is not capable of per-FR-gap, total interruption time on a serving cell during MGL is defined when MGL(N) = 20ms, 10ms, 6ms, 5.5ms, 4ms, 3.5ms, 3ms, and 1.5ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cells during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms, and 3ms, and total interruption time on FR2 serving cells during MGL is defined only when MGL(N) = 20ms, 10ms, 5.5ms, 3.5ms, and 1.5ms.

For NR-E-UTRA dual connectivity (with NR single carrier, NR CA configuration), if UE is not capable of per-FR-gap, total interruption time on MCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms, and 3ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cells in MCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms, and 3ms, and total interruption time on FR2 serving cells in MCG during MGL is defined only when MGL(N) = 20ms, 10ms, 5.5ms, 3.5ms, and 1.5ms.

For CA with non-aligned frame boundaries,

- The total interruption time on an SCC is the same as the case CA with aligned frame boundaries, if no SCC slots are partially overlapped with the measurement gap.

- The total interruption time on an SCC will be additionally extended by one SCC slot, if there exist SCC slots partially overlapped with the measurement gap.



(a) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for all serving cells in synchronous EN-DC, NR standalone operation (with single carrier, NR CA and synchronous NR-DC configuration) and synchronous NE-DC, and for serving cells in MCG in NR standalone operation (with asynchronous NR-DC configuration)



(b) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for all serving cells in synchronous EN-DC, NR standalone operation (with single carrier, NR CA and synchronous NR-DC configuration) and synchronous NE-DC, and for serving cells in MCG in NR standalone operation (with asynchronous NR-DC configuration)



(c) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for all serving cells in asynchronous EN-DC and asynchronous NE-DC, and for serving cells in SCG in NR standalone operation (with asynchronous NR-DC configuration)



(d) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for all serving cells in asynchronous EN-DC and asynchronous NE-DC, and for serving cells in SCG in NR standalone operation (with asynchronous NR-DC configuration)

Figure 9.1.2-1: Measurement GAP and total interruption time on serving cells for EN-DC, NR standalone operation (with single carrier, NR CA and NR-DC configuration) and NE-DC

The corresponding total number of interrupted slots on serving cells is listed in Table 9.1.2-4 for all serving cells in synchronous EN-DC, NR standalone (with single carrier, NR CA and synchronous NR-DC configuration) and NE-DC, and for serving cells in MCG in NR standalone operation (with asynchronous NR-DC configuration). The corresponding total number of interrupted slots on serving cells is listed in Table 9.1.2-4a for asynchronous EN-DC, and for serving cells in SCG in NR standalone operation (with asynchronous NR-DC configuration).

Table 9.1.2-4: Total number of interrupted slots on all serving cells during MGL for Synchronous EN-DC, NR standalone operation (with single carrier, NR CA and synchronous NR-DC configuration) and NE-DC, and on all serving cells in MCG for NR standalone operation (with asynchronous NR-DC configuration) with per-UE measurement gap or per-FR measurement gap for FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.5ms is applied | | | | |
| (kHz) | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 20 | 10 | 6 | 4 | 3 | 21Note3 | 11Note3 | 7Note3 | 5Note3 | 4Note3 |
| 30 | 40 | 20 | 12 | 8 | 6 | 40 | 20 | 12 | 8 | 6 |
| 60 | 80 | 40 | 24 | 16 | 12 | 80 | 40 | 24 | 16 | 12 |
| 120 | 160 | 80 | 48 | 32 | 24 | 160 | 80 | 48 | 32 | 24 |
| 480 Note4 | 640 | 320 | 192 | 128 | 96 | 640 | 320 | 192 | 128 | 96 |
| 480 Note5 | 641 | 321 | 193 | 129 | 97 | 641 | 321 | 193 | 129 | 97 |
| 960 Note4 | 1280 | 640 | 384 | 256 | 192 | 1280 | 640 | 384 | 256 | 192 |
| 960 Note5 | 1281 | 641 | 385 | 257 | 193 | 1281 | 641 | 385 | 257 | 193 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on MCG is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: NR SCSs of 120 kHz, 480kHz and 960kHz are only applicable to the case with per-UE measurement gap.  NOTE 3: Non-overlapped half-slots occur before and after the measurement gap. Whether a Rel-15 UE can receive and/or transmit in those half-slots is up to UE implementation.  NOTE 4: For NR SCSs of 480kHz and 960kHz, total number of interrupted slots on all serving cells during MGL for single carrier, intra-band NR CA with per-UE measurement gap.  NOTE 5: For NR SCSs of 480kHz and 960kHz, total number of interrupted slots on all serving cells in SCG for inter-band NR-CA and synchronous NR-DC with per-UE measurement gap. | | | | | | | | | | |

Table 9.1.2-4a: Total number of interrupted slots on serving cells during MGL for Asynchronous EN-DC, and on all serving cells in SCG for NR standalone operation (with asynchronous NR-DC configuration) with per-UE measurement gap or per-FR measurement gap for FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.5ms is applied | | | | |
| (kHz) | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 21 | 11 | 7 | 5 | 4 | 21 | 11 | 7 | 5 | 4 |
| 30 | 41 | 21 | 13 | 9 | 7 | 41 | 21 | 13 | 9 | 7 |
| 60 | 81 | 41 | 25 | 17 | 13 | 81 | 41 | 25 | 17 | 13 |
| 120 | 161 | 81 | 49 | 33 | 25 | 161 | 81 | 49 | 33 | 25 |
| 480 Note3 | 641 | 321 | 193 | 129 | 97 | 641 | 321 | 193 | 129 | 97 |
| 960 Note3 | 1281 | 641 | 385 | 257 | 193 | 1281 | 641 | 385 | 257 | 193 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on MCG is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: NR SCSs of 120 kHz, 480kHz and 960kHz are only applicable to the case with per-UE measurement gap.  NOTE 3: For NR SCSs of 480kHz and 960kHz, total number of interrupted slots on all serving cells in SCG for asynchronous NR-DC with per-UE measurement gap. | | | | | | | | | | |

In case that UE capable of per-FR measurement gap is configured with per-FR measurement gap for FR2 serving cells, total number of interrupted slots on FR2 serving cells during MGL is listed in Table9.1.2-4b.

**Table 9.1.2-4b: Total number of interrupted slots on FR2 serving cells during MGL for EN-DC, NR standalone operation (with single carrier, NR CA and NR-DC configuration) and NE-DC with per-UE measurement gap or per-FR measurement gap for FR2**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on FR2 serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.25ms is applied | | | | |
| (kHz) | MGL=  20ms | MGL=  10ms | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms | MGL=  20ms | MGL=  10ms | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms |
| 60 | 80 | 40 | 22 | 14 | 6 | 80 | 40 | 22 | 14 | 6 |
| 120 | 160 | 80 | 44 | 28 | 12 | 160 | 80 | 44 | 28 | 12 |
| 480 Note3 | 640 | 320 | 176 | 112 | 48 | 640 | 320 | 176 | 112 | 48 |
| 960 Note3 | 1280 | 640 | 352 | 224 | 96 | 1280 | 640 | 352 | 224 | 96 |
| NOTE 1: The total number of interrupted slots is based on that SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter *refServCellIndicator* is an FR2 serving cell.  NOTE 2: Slot occurs before or after the measurement gap may be interrupted additionally if SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter refServCellIndicator is an FR1 serving cell.  NOTE 3: For NR SCSs of 480kHz and 960kHz, Total number of interrupted slots on FR2-2 serving cells during MGL for NR standalone operation (single carrier, NR CA and NR-DC) with per-UE measurement gap or per-FR measurement gap for FR2-2. | | | | | | | | | | |

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

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

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

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

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

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

Table 9.1.2-5: (Void)

If a positioning measurement gap is configured via *PosGapConfig* and activated by MAC CE, the measurement requirements do not apply for RRM measurement that requires measurement gaps.

#### 9.1.2.1 EN-DC: Measurement Gap Sharing

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

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

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

When network signals “01”, “10” or “11” with RRC parameter *MeasGapSharingScheme* [2][16]and the value of X is defined as in Table 9.1.2.1-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

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

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2.1.

Table 9.1.2.1-1: Value of parameter X for EN-DC measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingScheme* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

#### 9.1.2.1a SA: Measurement Gap Sharing

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

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

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

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

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

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

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2.2.

Table 9.1.2.1a-1: Value of parameter X for NR standalone measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingScheme* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

#### 9.1.2.1b NE-DC: Measurement Gap Sharing

For NR-E-UTRA dual connectivity UE configured with per-UE measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on intra-frequency carriers or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers, E-UTRA gap-needed inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps, and/or inter-RAT E-UTRA carriers, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers.

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

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

When network signals “01”, “10” or “11” with RRC parameter *measGapSharingConfig* [2][16] and the value of X is defined as in Table 9.1.2.1b-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

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

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2.3.

Table 9.1.2.1b-1: Value of parameter X for NE-DC measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingScheme* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

#### 9.1.2.1c NR-DC: Measurement Gap Sharing

For UE with NR-DC operation and configured with per-UE measurement gap, measurement gap sharing shall be applies when UE required measurement gaps to identify and measure cells on intra-frequency carriers or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers for both SSB and CSI-RS based L3 measurement, and/or inter-RAT E-UTRAN carriers, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers.

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

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

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

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

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

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2..4.

Table 9.1.2.1c-1: Value of parameter X for NR-DC measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingConfig* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

### 9.1.3 UE Measurement capability

#### 9.1.3.1 EN-DC: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE capable of and configured with the EN-DC operation mode.

When monitoring of multiple inter-frequency E-UTRAN, inter-RAT NR, GSM, UTRA FDD and UTRA TDD carriers as configured by E-UTRA PCell, and inter-frequency NR carriers (with or without CCA) as configured by PSCell using gaps (or without using gaps provided the UE supports such capability or the effective MGRP is applied for per-FR measurement gap capable UE) is configured, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR, SFTD, E-UTRAN RSRP, E-UTRAN RSRQ, E-UTRAN RS-SINR measurements, UTRAN TDD P-CCPCH RSCP, UTRAN FDD CPICH measurements, GSM carrier RSSI, etc.) of detected cells on all the layers.

For UE configured with the EN-DC operation, the effective total number of frequencies excluding the frequencies of the PSCell, SCells, E-UTRA PCell, and E-UTRA SCells being monitored is Nfreq, EN-DC, which is defined as:

Nfreq, EN-DC = Nfreq, EN-DC, NR + Nfreq, EN-DC, E-UTRA+ Nfreq, EN-DC, UTRA + MEN-DC, GSM,

where

Nfreq, EN-DC, E-UTRA is the number of E-UTRA inter-frequency carriers being monitored (FDD and TDD) as configured by E-UTRA PCell or via LPP [22],

Nfreq, EN-DC, NR ≤ Nfreq, EN-DC, NR, inter-RAT + Nfreq, EN-DC, NR, inter-freq

where

Nfreq, EN-DC, NR, inter-RAT is the number of NR inter-RAT carriers excluding NR serving carrier(s) being monitored as configured by E-UTRA PCell [15],

Nfreq, EN-DC, NR, inter-freq is the number of NR inter-frequency carriers being monitored as configured by PSCell,

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

MEN-DC, GSM is an integer which is a function of the number of GSM inter-RAT carriers as configured by E-UTRA PCell on which measurements are being performed. MEN-DC, GSM is equal to 0 if no GSM carrier is being monitored. For a MGRP of 40 ms, MEN-DC, GSM is equal to 1 if cells on up to 32 GSM carriers are being measured. For a MGRP of 80 ms, MEN-DC, GSM is equal to ceil(Ncarriers,GSM /20) where Ncarriers,GSM is the number of GSM carriers on which cells are being measured.

#### 9.1.3.1a SA: Monitoring of multiple layers using gaps

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

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

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

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

where

Nfreq, SA, E-UTRA is the number of E-UTRA inter-RAT carriers being monitored (FDD and TDD) as configured by PCell or via LPP [22],

- Nfreq, SA, UTRA is the number of UTRA FDD inter-RAT carriers being monitored as configured by PCell,

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

#### 9.1.3.1b NE-DC: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE capable of and configured with the NE-DC operation mode.

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

For UE configured with the NE-DC operation, the effective total number of frequencies excluding the frequencies of the PCell, SCells, E-UTRA PSCell, and E-UTRA SCells being monitored is Nfreq, NE-DC, which is defined as:

Nfreq, NE-DC = Nfreq, NE-DC, NR + Nfreq, NE-DC, E-UTRA+ Nfreq, NE-DC, UTRA,

where

Nfreq, NE-DC, NR is the number of NR inter-frequency carriers being monitored as configured by PCell,

Nfreq, NE-DC, UTRA is the number of UTRA FDD inter-RAT carriers being monitored as configured by PCell,

Nfreq, NE-DC, E-UTRA ≤ Nfreq, NE-DC, E-UTRA, inter-RAT + Nfreq, NE-DC, E-UTRA, inter-freq

where

Nfreq, NE-DC, E-UTRA, inter-RAT is the number of E-UTRA inter-RAT carriers (FDD and TDD) excluding E-UTRA serving carrier(s) being monitored as configured by PCell or via LPP [22],

Nfreq, NE-DC, E-UTRA, inter-freq is the number of E-UTRA inter-frequency carriers (FDD and TDD) being monitored as configured by E-UTRA PSCell [15] or via LPP [22].

#### 9.1.3.1c NR-DC: Monitoring of multiple layers using gaps

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

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

For UE configured with the NR-DC operation, the effective total number of frequencies, excluding the frequencies of the PCell, PSCell and SCells being monitored, is Nfreq, NR-DC, which is defined as:

Nfreq, NR-DC = Nfreq, NR-DC, NR + Nfreq, NR-DC, E-UTRA+ Nfreq, NR-DC, UTRA,

where

- Nfreq, NR-DC, E-UTRA is the number of E-UTRA inter-RAT carriers being monitored (FDD and TDD) as configured by PCell or via LPP [22].

- Nfreq, NE-DC, UTRA is the number of UTRA FDD inter-RAT carriers being monitored as configured by PCell,

- Nfreq, NR-DC, NR is the number of NR inter-frequency carriers being monitored as configured by PCell and PSCell.

#### 9.1.3.2 EN-DC: Maximum allowed layers for multiple monitoring

If a UE is configured with EN-DC operation, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PSCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PSCell, and

- Depending on UE capability, 7 NR SSB inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA TDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA FDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 3 FDD UTRA carriers, and

- Depending on UE capability, 3 TDD UTRA carriers, and

- Depending on UE capability, 32 GSM carriers (one GSM layer corresponds to 32 carriers), and

- Depending on UE capability, 1 E-UTRA FDD inter-frequency carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-frequency carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD, UTRA FDD, UTRA TDD and GSM (one GSM layer corresponds to 32 carriers) layers. The UE shall be capable of monitoring a total of at least 7 + NCSI effective NR carrier frequency layers excluding NR serving carrier(s), comprising of any above defined combination of NR inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell and NR inter-frequency carriers configured by PSCell, NCSI equals 1 if UE supports CSI-RS based L3 measurement, and NCSI =0 otherwise.

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

- *ssb-ConfigMobility* configured, or

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

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

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

When the E-UTRA PCell and PSCell configures the same NR carrier frequency layer to be monitored by the UE in synchronous intra-band EN-DC, this layer shall be counted only once to the total number of effective carrier frequency layers provided that the SFN-s and slot boundaries are aligned, unless the configured NR carrier frequency layers to be monitored have

- different RSSI measurement resourcesor

- different *deriveSSB-IndexFromCell* indications or

- different SMTC configurations or

- different *ssb-PositionQCL-Common-r16* indications or cell list of *ssb-PositionQCL* on NR carrier frequency layer with CCA or

- different *rmtc-Config-r16* indication on NR carrier frequency layer with CCA.

Note 1: The E-UTRA-NR dual connectivity capable UE configured with PSCell shall fulfil the requirements defined in only one of clause 9.1.3.2 and clause 8.1.2.1.1b.1 of TS 36.133 [15].

#### 9.1.3.2a SA: Maximum allowed layers for multiple monitoring

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

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

- Depending on UE capability, 7 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 3 UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 1 E-UTRA FDD inter-RAT carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-RAT carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least [13] effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD and UTRA FDD layers.

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

- *ssb-ConfigMobility* configured, or

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

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

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

#### 9.1.3.2b NE-DC: Maximum allowed layers for multiple monitoring

If a UE is configured with NE-DC operation mode, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

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

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

- Depending on UE capability, 6 E-UTRA TDD inter-frequency carriers configured by E-UTRA PSCell [15], and

- Depending on UE capability, 6 E-UTRA FDD inter-frequency carriers configured by E-UTRA PSCell [15], and

- Depending on UE capability, 3 UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 1 E-UTRA FDD inter-frequency carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-frequency carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD and UTRA FDD layers. The UE shall be capable of monitoring a total of at least 6 effective E-UTRA carrier frequency layers, excluding E-UTRA serving carrier(s), comprising of any above defined combination of E-UTRA inter-RAT carriers excluding E-UTRA serving carrier(s) configured by PCell and E-UTRA inter-frequency carriers configured by E-UTRA PSCell.

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

- *ssb-ConfigMobility* configured, or

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

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

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

#### 9.1.3.2c NR-DC: Maximum allowed layers for multiple monitoring

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

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PSCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PSCell, and

- Depending on UE capability, 7 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 3 UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 1 E-UTRA FDD inter-RAT carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-RAT carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD and UTRA FDD layers. The UE shall be capable of monitoring a total of at least 7 + NCSI effective NR carrier frequency layers excluding NR serving carrier(s), which are configured by PCell and PSCell, NCSI equals 1 if UE supports CSI-RS based L3 measurement, and NCSI =0 otherwise.

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

- *ssb-ConfigMobility* configured, or

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

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

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

When PCell and PSCell configures the same NR carrier frequency layer to be monitored by the UE in NR-DC, this layer shall be counted only once to the total number of effective carrier frequency layers provided that the SFN-s and slot boundaries are aligned, unless the configured NR carrier frequency layers to be monitored have

- different RSSI measurement resourcesor

- different *deriveSSB-IndexFromCell* indications or

- different SMTC configurations or

- different *ssb-PositionQCL-Common-r16* indications or cell list of *ssb-PositionQCL* on NR carrier frequency layer with CCA or

- different *rmtc-Config-r16* indication on NR carrier frequency layer with CCA.

#### 9.1A.3.2 Void

### 9.1.3A UE Measurement capability under operation mode with CCA

#### 9.1.3A.1 EN-DC: Monitoring of multiple layers using gaps under CCA

The requirements in clause 9.1.3.1 are also applicable for the UE capable of and configured with the EN-DC operation mode with CCA on PSCC.

#### 9.1.3A.1a SA: Monitoring of multiple layers using gaps under CCA

The requirements in clause 9.1.3.1a are also applicable for UE configured with SA NR operation mode with CCA on PCC.

#### 9.1.3A.2 EN-DC: Maximum allowed layers for multiple monitoring under CCA

If a UE is configured with EN-DC operation when CCA is used on PSCell, the UE shall be capable of monitoring at least:

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

- Depending on UE capability, 7 NR inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA TDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA FDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 3 FDD UTRA carriers, and

- Depending on UE capability, 3 TDD UTRA carriers, and

- Depending on UE capability, 32 GSM carriers (one GSM layer corresponds to 32 carriers), and

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD, UTRA FDD, UTRA TDD and GSM (one GSM layer corresponds to 32 carriers) layers. The UE shall be capable of monitoring a total of at least 7 effective NR carrier frequency layers excluding NR serving carrier(s), comprising of any above defined combination of NR inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell and NR inter-frequency carriers configured by PSCell.

When the E-UTRA PCell and PSCell configures the same NR carrier frequency layer to be monitored by the UE in synchronous intra-band EN-DC, this layer shall be counted only once to the total number of effective carrier frequency layers provided that the SFN-s and slot boundaries are aligned, unless the configured NR carrier frequency layers to be monitored have

- different RSSI measurement resourcesor

- different *deriveSSB-IndexFromCell* indications or

- different SMTC configurations or

- different *ssb-PositionQCL-Common-r16* indications or cell list of *ssb-PositionQCL* on NR carrier frequency layer with CCA or

- different *rmtc-Config-r16* indication on NR carrier frequency layer with CCA.

#### 9.1.3A.2a SA: Maximum allowed layers for multiple monitoring under CCA

If a UE is configured with SA NR operation mode when CCA is used on PCell or SCell only, the UE shall be capable of monitoring at least:

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

- Depending on UE capability, 7 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA FDD inter-RAT carriers configured by PCell, and

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least [13] effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD and E-UTRA TDD layers.

### 9.1.3C UE Measurement capability under operation mode with satellite access

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

#### 9.1.3C.1a SA: Monitoring of multiple layers using gaps under satellite access

The requirements in this clause are applicable for UE configured with only PCell, which is served by SAN.

When monitoring of multiple SAN carriers and TN carriers using gaps (or without using gaps provided the UE supports such capability) is configured by PCell, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR) of detected cells on all the layers.

Note: for a cell served by SAN, the UE could only be configured to measure SS-RSRP, SS-RSRQ, SS-SINR.

For the UE configured with NR SA operation mode with only PCell served by SAN, the effective total number of frequencies, excluding the frequencies of the serving cell being monitored, is Nfreq, SA, which is defined as:

Nfreq, SA = Nfreq, SA, SAN + Nfreq, SA, TN,

where

- Nfreq, SA, SAN is the number of SAN carriers being monitored as configured by the serving cell served by SAN,

Nfreq, SA, TN is the number of TN carriers being monitored as configured by the serving cell served by SAN.

#### 9.1.3C.2a SA: Maximum allowed layers for multiple monitoring for SAN

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

- Depending on UE capability, 3 NR SAN carriers including serving carrier, and

- Depending on UE capability, 7 NR SAN and TN carriers including serving carrier,

- The total number of NR SAN and TN carriers does not apply to VSAT UE.

FFS: the number of effective frequency layers UE shall be capable to monitor.

### 9.1.4 Capabilities for Support of Event Triggering and Reporting Criteria

#### 9.1.4.1 Introduction

This clause contains requirements on UE capabilities for support of event triggering and reporting criteria. As long as the measurement configuration does not exceed the requirements stated in clause 9.1.4.2, the UE shall meet all other performance requirements defined in clause 9 and clause 10. The requirements in this clause also apply for a UE in EN-DC with PSCell on a carrier frequency with CCA or SA NR with PCell on a carrier frequency with CCA.

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

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

#### 9.1.4.2 Requirements

In this clause a reporting criterion corresponds to either one event (in the case of event-based reporting), or one periodic reporting criterion (in case of periodic reporting), or one no reporting criterion (in case of no reporting). For event-based reporting, each instance of event, with the same or different event identities, is counted as separate reporting criterion in Table 9.1.4.2-1.

The UE shall be able to support in parallel per category up to Ecat reporting criteria according to Table 9.1.4.2-1. For the measurement categories belonging to intra-frequency, inter-frequency, and inter-RAT measurements (i.e. without counting other categories that the UE shall always support in parallel), the UE need not support more than the total number of reporting criteria as follows:

- For UE configured with EN-DC: , where

is the total number of NR reporting criteria configured by PSCell (NR intra- and inter-frequency reporting criteria) and by E-UTRA PCell on NR serving frequencies (NR intra-frequency reporting criteria) applicable for UE configured with EN-DC according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PSCell and SCells carrier frequencies,

is the total number of reporting criteria configured by E-UTRA PCell except PSCell and SCells carrier frequencies, as specified in TS 36.133 [15] for UE configured with EN-DC.

- For UE configured with NE-DC:, where

is the total number of NR reporting criteria according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PCell and SCells carrier frequencies,

, where

is the total number of inter-RAT E-UTRA reporting criteria configured by PCell except E-UTRA PSCell and E-UTRA SCells carrier frequencies, according to Table 9.1.4.2-1,

is the total number of E-UTRA reporting criteria including E-UTRA PSCell and E-UTRA SCells carrier frequencies as specified in TS 36.133 [15] for UE configured with NE-DC.

- For UE configured with SA operation mode: , where

 is the total number of NR reporting criteria according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PCell, and SCells carrier frequencies,

 is the total number of inter-RAT E-UTRA reporting criteria according to Table 9.1.4.2-1.

- For UE configured with NR-DC: , where

is the total number of NR reporting criteria according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PCell, PSCell and SCells carrier frequencies,

is the total number of inter-RAT E-UTRA reporting criteria according to Table 9.1.4.2-1.

Table 9.1.4.2-1: Requirements for reporting criteria per measurement category

|  |  |  |
| --- | --- | --- |
| Measurement category | Ecat | Note |
| Intra-frequency Note 1,2,3,4,5 | 9 | Events for any one or a combination of intra-frequency SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, and CSI-SINR for NG-RAN intra-frequency cells |
| Inter-frequency Note 2,3,4,5 | 10 | Events for any one or a combination of inter-frequency SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, and CSI-SINR for NG-RAN inter-frequency cells |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) Note 2,4,5 | 10 | Only applicable for UE with this (inter-RAT) capability. These reporting criteria apply for any E-UTRA carrier frequencies other than the carrier frequency of the E-UTRA PSCell or E-UTRA SCell. |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) RSTD Note 2,4,5 | 1 | Inter-RAT RSTD measurement reporting for UE supporting OTDOA; 1 report capable of minimum 16 inter-RAT cell measurements.  Only applicable for UE with this (inter-RAT RSTD via LPP [22]) capability. These reporting criteria apply for any E-UTRA carrier frequencies other than the carrier frequency of the E-UTRA PSCell or E-UTRA SCell. |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) RSRP and RSRQ measurements for E-CID Note 2,4,5 | 1 | Inter-RAT RSRP and RSRQ measurements for E-CID reported to E-SMLC via LPP [22]. One report capable of at least in total 10 inter-RAT RSRP and RSRQ measurements. Applicable to UE capable of reporting inter-RAT RSRP and RSRQ to E-SMLC via LPP. These reporting criteria apply for any E-UTRA carrier frequencies other than the carrier frequency of the E-UTRA PSCell or E-UTRA SCell. |
| Intra-frequency RSSI and channel occupancy measurements with CCA Note 1,2,3 | 1 | One report capable of one RSSI and one channel occupancy measurements over a channel [TS 37.213] with CCA. Applicable for UE capable of performing and reporting RSSI and channel occupancy on carrier frequencies under CCA. |
| Inter-frequency RSSI and channel occupancy measurements with CCA Note 2,3 | 1 | One report capable of one RSSI and one channel occupancy measurements over a channel [TS 37.213] with CCA. Applicable for UE capable of performing and reporting RSSI and channel occupancy on carrier frequencies under CCA. |
| Intra-frequency SSB-based measurements for NR E-CID Note 1,2,3,4,5 | 1 | Intra-frequency SS-RSRP and SS-RSRQ measurements for NR E-CID reported to LMF via LPP [34]. One report capable of at least in total 9 intra-frequency SS-RSRP and SS-RSRQ measurements. Applicable to UE capable of reporting at least one of SS-RSRP and SS-RSRQ to LMF via LPP. |
| Intra-frequency CSI-RS based measurements for NR E-CID Note 1,2,3,4,5 | 1 | Intra-frequency CSI-RSRP and CSI-RSRQ measurements for NR E-CID reported to LMF via LPP [22]. One report capable of at least in total 9 intra-frequency CSI-RSRP and/or CSI-RSRQ measurements. Applicable to UE capable of reporting any of CSI-RSRP and CSI-RSRQ to LMF via LPP, as indicated in *nr-ECID-MeasSupported-r16*. |
| Inter-frequency SSB-based measurements for NR E-CID Note 2,3,4,5 | 1 | Inter-frequency SS-RSRP and SS-RSRQ measurements for NR E-CID reported to LMF via LPP [34]. One report capable of at least in total 10 inter-frequency SS-RSRP and SS-RSRQ measurements. Applicable to UE capable of reporting at least one of SS-RSRP and SS-RSRQ to LMF via LPP. |
| Inter-frequency CSI-RS based measurements for NR E-CID Note 2,3,4,5 | 1 | Inter-frequency CSI-RSRP and CSI-RSRQ measurements for NR E-CID reported to LMF via LPP [22]. One report capable of at least in total 10 inter-frequency CSI-RSRP and CSI-RSRQ measurements. Applicable to UE capable of reporting any of CSI-RSRP and CSI-RSRQ to LMF via LPP, as indicated in *nr-ECID-MeasSupported-r16*. |
| DL RSTD Note 2,4,5 | 1 | DL RSTD measurement reporting; 1 report capable of multiple (within the UE PRS measurement capability, *nr-DL-TDOA-MeasCapability*, indicated via LPP [34]) DL RSTD measurements and if supported also multiple corresponding DL PRS-RSRP measurements configured for DL-TDOA. Only applicable for UE capable of reporting measurements for DL-TDOA to LMF via LPP [34]. |
| UE Rx-Tx Note 2,4,5 | 1 | UE Rx-Tx measurement reporting; 1 report capable of multiple (within the UE PRS measurement capability, *nr-DL-PRS-MeasCapability*, indicated via LPP [34] for multi-RTT) UE Rx-Tx measurements and if supported also multiple corresponding DL PRS-RSRP measurements configured for multi-RTT. Only applicable for UE capable of reporting measurements for multi-RTT to LMF via LPP [34]. |
| DL PRS-RSRP Note 2,4,5 | 1 | DL PRS-RSRP measurement reporting; 1 report capable of multiple (within the UE PRS measurement capability, *nr-DL-PRS-MeasCapability*, indicated via LPP [34] for AoD) DL PRS-RSRP measurements configured for DL-AoD. Only applicable for UE capable of reporting measurements for DL-AoD to LMF via LPP [34]. |
| SRS-RSRP Note 2,3,4,5 | 1 | SRS-RSRP measurement reporting for CLI; 1 report capable of up to 32 SRS resources measurements. Only applicable for UE supporting *cli-SRS-RSRP-Meas-r16*. |
| CLI-RSSI Note 2,3,4,5 | 1 | CLI-RSSI measurement reporting for CLI; 1 report capable of up to 64 CLi-RSSI resources measurements. Only applicable for UE supporting *cli-RSSI-Meas-r16*. |
| NOTE 1: When the UE is configured with PSCell and SCell carrier frequencies, Ecat for Intra-frequency is applied per corresponding NR serving frequency.  NOTE 2: Applicable for UE configured with SA NR operation mode.  NOTE 3: Applicable for UE configured with EN-DC operation mode.  NOTE 4: Applicable for UE configured with NE-DC operation mode.  NOTE 5: Applicable for UE configured with NR-DC operation mode. | | |

### 9.1.5 Carrier-specific scaling factor

This clause specifies the derivation of carrier-specific scaling factor (CSSF) values, which scales the measurement delay requirements given in clause 9.2, 9.2A, 9.3, 9.3A, 9.4, and NR PRS-based positioning measurements in clause 9.9 and CSI-RS based L3 measurement in clause 9.10 when UE is configured to monitor multiple measurement objects. The CSSF values are categorized into CSSFoutside\_gap,i andCSSFwithin\_gap,i, for the measurements conducted outside measurement gaps and within measurement gaps, respectively.

If concurrent measurement gaps are configured by the network, subject to UE capability, [the term of the union of concurrent measurement gaps in the following clauses refer to non-dropped measurement gap occasions after accounting for measurment gap collisions as specified in clause 9.1.8.3 from all the configured measurement gap patterns. The term of the associated measurement gap in concurrent measurement gaps in the following clauses refer to non-dropped measurement gap occasions associated by measurement object *i* after accounting for measurment gap collisions as specified in clause 9.1.8.3].

#### 9.1.5.1 Monitoring of multiple layers outside gaps

For a UE supporting concurrent gaps and when concurrent gaps are configured the carrier-specific scaling factor CSSFoutside\_gap,i for measurement object *i* derived in this chapter is applied to following measurement types :

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap or the union of concurrent measurement gaps.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or the union of concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

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

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based inter-RAT measurement object configured by the E-UTRAN PCell on an NR serving carrier

- the SSB is completely contained in the active BWP of the UE, and

- none or part of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based inter-RAT measurement object configured by the E-UTRAN PCell on an NR serving carrier

- the SSB is completely contained in the active BWP of the UE, and

- none or part of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- Intra-frequency RSSI and channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping and RMTCs are not fully overlapped with measurement gap(s).

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

For a UE in E-UTRA-NR dual connectivity operation, if a measurement object configured by PSCell and an NR inter-RAT measurment object configured by E-UTRAN PCell are on the same serving carrier, they shall be counted as one intra-frequency measurement object, provided that they meet the measurement object merging conditions [in clause 9.1.3.2].

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

- *ssb-ConfigMobility* configured, or

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

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

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFoutside\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

The UE cell identification and measurement periods derived based on CSSFoutside\_gap,i in clauses 9.2.5.1, 9.2.5.2 and 9.10.2 may be extended for measurement objects of which the cell identification and measurement periods are overlapped with Tmeasure\_SFTD1 specified in clause 9.3.8 when no measurement gaps are provided.

The requirements in this clause apply provided that

- The SMTC on all CCs and inter-frequency layers without measurement gap in FR2 have the same offset, and one of following conditions is met

- If *smtc2* is configured on any FR2 CC,

- All CCs have the same configuration for *smtc1*, and

- All CCs configured with *smtc2* have the same configuration for *smtc2*

- If *smtc2* is not configured on any FR2 CC,

- The total number of different SMTC periodicities on all serving CCs and inter-frequency layers without measurement gap does not exceed 4

- The starting point of the first 5ms window for CSI-RS measurement as defined in clause 9.10.1 on all CCs in FR2 is same and one of following conditions is met

- If any CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC,

- All CCs with CSI-RS resources only in the first 5ms window have the same CSI-RS resource periodcity, and

- All CCs with CSI-RS resources both in the first and the second 5ms window have the same CSI-RS resource periodcity

- If no CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC,

- The total number of different CSI-RS resources periodicities on all serving CCs does not exceed 3Note: Longer delays for cell identification and measurement periods derived based on CSSFoutside\_gap,i in clauses 9.2.5.1, 9.2.5.2, can be expected, if the UE is configured with more than 4 different SMTC periodicities on FR2 serving carriers. The longer delay applies for the FR2 intra-frequency measurement objects with the longest SMTC periodicity/periodicities.

##### 9.1.5.1.1 EN-DC mode: carrier-specific scaling factor for SSB-based, CSI-RS based L3 measurements and RSSI and channel occupancy measurements performed outside gaps

For UE configured with the E-UTRA-NR dual connectivity operation, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurements, inter-frequency SSB-based measurements performed outside measurements gaps, intra-frequency CSI-RS L3 measurement and RSSI/channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping will be as specified in Table 9.1.5.1.1-1.

Table 9.1.5.1.1-1: CSSFoutside\_gap,i scaling factor for EN-DC mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PSCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PSCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required Note 2 | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gp |
| **EN-DC with FR1 only CA** | 1+NPSCC\_CSIRS+NPSCC\_CCA\_RSSI/CO | NSCC\_SSB +Y+2x NSCC\_CSIRS+ NSCC\_CCA\_RSSI/CO | N/A | N/A | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **EN-DC with**  **FR2 only intra band CA** | N/A | N/A | 1+NPSCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **EN-DC with**  **FR2 only inter band CA** | N/A | N/A | 1+NPSCC\_CSIRS | 2x(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **EN-DC with**  **FR1 +FR2 CA (FR1 PSCell) Note 1** | 1+NPSCC\_CSIRS | 2×( NSCC\_SSB +Y+2xNSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | N/A | 2x(1+NSCC\_CSIRS\_FR2\_NCM) Note 3 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **EN-DC with**  **FR1 +FR2 CA (FR2 PSCell) Note 1** | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | 1+NPSCC\_CSIRS | N/A | NSCC\_SSB+Y+2x NSCC\_CSIRS | NSCC\_SSB+Y+2x NSCC\_CSIRS |
| Note 1: Only one NR FR1 operating band and one NR FR2 operating band are included for FR1+FR2 inter-band EN-DC.  Note 2: Selection of FR2 SCC where neighbour cell measurement is required follows clause 9.2.3.2.  Note 3: CSSFoutside\_gap,i =1 if only one SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on SCC; CSSFoutside\_gap,i =2 if only one SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on SCC.  Note 4: Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG; otherwise, it is 0.  Note 5: Only two NR FR2 operating band are included for EN-DC with FR2 only inter-band CA  Note 6: NPSCC\_CSIRS=1 if PSCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPSCC\_CSIRS =0.  Note 7: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_CSIRS\_FR2\_NCM=1 if FR2 SCC, where neighbour cell measurement is required, is with either both SSB and CSI-RS configured or only CSI-RS measurement configured; otherwise, NSCC\_CSIRS\_FR2\_NCM=0.  Note 9: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG.  Note 10: NPSCC\_CCA\_RSSI/CO= 1 if PSCC is configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping; NSCC\_CCA\_RSSI/CO = Number of MOs for SCell(s) configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping.  Note 11 If a measurement object configured by PSCell and an NR inter-RAT measurment object configured by E-UTRAN PCell are on the same serving carrier, they shall be counted as one intra-frequency measurement object, provided that they meet the measurement object merging conditions [in clause 9.1.3.2], otherwise they are counted separately as two measurement objects. | | | | | | |

##### 9.1.5.1.2 SA mode: carrier-specific scaling factor for SSB-based, CSI-RS based L3 measurements and RSSI and channel occupancy measurements performed outside gaps

For UE in SA operation mode, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurements, inter-frequency SSB-based measurements performed outside measurements gaps, intra-frequency CSI-RS L3 measurement and RSSI/channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping will be as specified in Table 9.1.5.1.2-1, which shall also be applied for a UE configured with NE-DC operation.

Table 9.1.5.1.2-1: CSSFoutside\_gap,i scaling factor for SA mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required | *CSSF* outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gap |
| **FR1 only CA** | 1+NPCC\_CSIRS + NPCC\_CCA\_RSSI/CO | NSCC\_SSB +Y+2x NSCC\_CSIRS+ NSCC\_CCA\_RSSI/CO | N/A | N/A | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **FR2 only intra band CA** | N/A | N/A | 1+NPCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **FR2 only inter band CA** | N/A | N/A | 1+NPCC\_CSIRS | 2\*(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **FR1 +FR2 CA (FR1 PCell) Note 1** | 1+NPCC\_CSIRS | 2×( NSCC\_SSB +Y+2\* NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | N/A | 2x(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **FR1 +FR2 CA (FR2 PCell) Note 1** | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | 1+NPCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| Note 1: Only one FR1 operating band and one FR2 operating band are included for FR1+FR2 inter-band CA.  Note 2: Selection of FR2 SCC where neighbour cell measurement is required follows clause 9.2.3.2.  Note 3: CSSFoutside\_gap,i =1 if only one SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on SCC; CSSFoutside\_gap,i =2 if only one SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on SCC.  Note 4: Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG; otherwise, it is 0.  Note 5: Only two NR FR2 operating bands are included for FR2 inter-band CA.  Note 6: NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.  Note 7: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_CSIRS\_FR2\_NCM=1 if FR2 SCC, where neighbour cell measurement is required, is with either both SSB and CSI-RS configured or only CSI-RS measurement configured; otherwise, NSCC\_CSIRS\_FR2\_NCM=0.  Note 9: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG.  Note 10: NPCC\_CCA\_RSSI/CO= 1 if PSCC is configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping; NSCC\_CCA\_RSSI/CO = Number of MOs for SCell(s) configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping. | | | | | | |

##### 9.1.5.1.3 NR-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed outside gaps

For UE configured with NR-DC operation, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurement, inter-frequency SSB-based measurements performed outside measurements gaps and intra-frequency CSI-RS based L3 measurement will be as specified in Table 9.1.5.1.3-1.

Table 9.1.5.1.3-1: CSSFoutside\_gap,i scaling factor for NR-DC mode

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PSCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gap |
| **FR1 + FR2 NR-DC (FR1 PCell and FR2 PScell) Note 1** | 1+NPCC\_CSIRS | 2×( NSCC\_SSB +Y+2xNSCC\_CSIRS) | 2x(1+ NPSCC\_CSIRS) Note 2 | 2x(NSCC\_SSB +Y+2x NSCC\_CSIRS ) | 2x(NSCC\_SSB +Y+2x NSCC\_CSIRS ) |
| Note 1: NR-DC in Rel-15 only includes the scenarios where all serving cells in MCG in FR1 and all serving cells in SCG in FR2.  Note 2: CSSFoutside\_gap,i =1 if no SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on PSCC; CSSFoutside\_gap,i =2 if no SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on PSCC.  Note 3: Y is the number of configured inter-frequency SSB based frequency layers without MG that are being measured outside of MG; otherwise, it is 0.  Note 4: NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.  Note 5: NPSCC\_CSIRS=1 if PSCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPSCC\_CSIRS =0.  Note 6: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG. | | | | | |

##### 9.1.5.1.4 NE-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based measurements performed outside gaps

For UE configured with NE-DC operation, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurement and inter-frequency SSB-based measurements performed outside measurements gaps and intra-frequency CSI-RS based L3 measurement will be as specified in Table 9.1.5.1.4-1.

Table 9.1.5.1.4-1: CSSFoutside\_gap,i scaling factor for NE-DC mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gap |
| **NE-DC with FR1 only CA** | 1+NPCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS | N/A | N/A | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **NE-DC with FR2 only intra band CA** | N/A | N/A | 1+NPCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **NE-DC with**  **FR2 only inter band CA** | N/A | N/A | 1+NPCC\_CSIRS | 2\*(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **NE-DC with FR1 +FR2 CA (FR1 PCell) Note 1** | 1+NPCC\_CSIRS | 2×( NSCC\_SSB +Y+2\* NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | N/A | 2x(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| Note 1: Only one FR1 operating band and one FR2 operating band are included for FR1+FR2 inter-band CA.  Note 2: Selection of FR2 SCC where neighbour cell measurement is required follows clause 9.2.3.2.  Note 3: CSSFoutside\_gap,i =1 if only one SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on SCC; CSSFoutside\_gap,i =2 if only one SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on SCC.  Note 4: Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG; otherwise, it is 0.  Note 5: Only two NR FR2 operating band are included for NE-DC with FR2 only inter-band CA.  Note 6: NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.  Note 7: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_CSIRS\_FR2\_NCM=1 if FR2 SCC, where neighbour cell measurement is required, is with either both SSB and CSI-RS configured or only CSI-RS measurement configured; otherwise, NSCC\_CSIRS\_FR2\_NCM=0.  Note 9: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG. | | | | | | |

#### 9.1.5.2 Monitoring of multiple layers within gaps

For a UE supporting concurrent gaps and when concurrent gaps are configured the carrier-specific scaling factor CSSFwithin\_gap,i for a measurement object *i* derived in this chapter is applied to following measurement types for the associated measurement gap:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when

- all of the SMTC occasions of this intra-frequency measurement object are overlapped with the measurement gap or associated measurement gap in concurrent measurement gaps, or

- part of the SMTC occasions of this intra-frequency measurement object are overlapped with the associated measurement gap and all the SMTC occasions of this intra-frequency measurement object are overlapped with the union of all the measurement gaps.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap or the associated measurement gap in concurrent measurement gaps.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap or the associated measurement gap in concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped with the associated measurement gap and all CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped with the union of the configured concurrent measurement gaps.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped with the measurement gap or associated measurement gap in concurrent measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped with the associated measurement gap and all the SMTC occasions of this inter-frequency measurement object are overlapped with the union of all the measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or associated measurement gap in concurrent measurement gaps and the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

Otherwise, the carrier-specific scaling factor CSSFwithin\_gap,i for a measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- Intra-frequency RSSI/CO measurement with measurement gap in clause 9.2A.7.

- Intra-frequency RSSI/CO measurement with no measurement gap in clause 9.2A.7 when all of the RMTC occasions of this intra-frequency RSSI/CO measurement are overlapped by the measurement gap(s).

- Inter-frequency RSSI/CO measurement in clause 9.3A.8 and 9.3A.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT RSTD and E-CID measurements in clauses 9.4.4 and 9.4.5.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR serving carrier

- the SSB is not completely contained in the active BWP of the UE, or

- all of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR non-serving carrier.

- E-UTRAN Inter-frequency measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.3) and by the E-UTRAN PSCell (TS 36.133 [15] clause 8.19.3).

- E-UTRAN Inter-frequency RSTD measurement configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.15).

- UTRA Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.5 to 8.17.12).

- GSM Inter-RAT measurements configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.13 and 8.17.14).

The UE is expected to conduct the measurement of this measurement object *i* only within the measurement gap or the associated measurement gap if concurrent measurement gaps are configured. If UE is configured with concurrent measurement gaps and an association between measurement object i and certain measurement gap is provided, the requirements are defined assuming the UE shall conduct the measurement of this measurement object *i* within the associated measurement gap.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

Number of SSB layers should include SSB for mobility and that as associated SSB for CSI-RS mobility. the ssbfrequency is counted only once if the ssbfrequency for mobility and associated SSB are the same, or ssbfrequency and smtc in multiple MOs are the same.

Editor’s note: FFS how to add the layer corresponding to the associated SSB for a MO with only CSI-RS measurement configured.

##### 9.1.5.2.1 EN-DC mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps

The scaling value CSSFwithin\_gap,i below has been derived without considering GSM inter-RAT carriers.

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*.

For a UE in E-UTRA-NR dual connectivity operation, if a SSB-based measurement object configured by PSCell and an NR SSB-based inter-RAT measurement object configured by E-UTRAN PCell are on the same carrier, they shall be counted as one measurement object in Mtot,i,j, provided that they meet the measurement object merging conditions [in clause 9.1.3.2].

If measurement object *i* refers to an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including RSTD measurement with periodicity Tprs=160ms) participate in the gap competition are derived as below.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR carriers, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time. -

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-RAT UTRA measurement object configured by E-UTRA PCell [15] is a candidate to be measured in all measurement gaps.

- An inter-frequency E-UTRA measurement object configured by E-UTRA PCell [15] is a candidate to be measured in all measurement gaps.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurement, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based NR inter-RAT frequency layer and RSSI/CO measurement, configured by E-UTRA PCell, EUTRA inter-frequency measurement objects configured by E-UTRA PCell, or UTRA inter-RAT measurement objects configured by E-UTRA PCell which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequency layers which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, Mintra,i,j = Minter,i,j = Mtot,i,j =0.

The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 1280ms period.

##### 9.1.5.2.2 SA mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*.

If a UE capable of concurrent gaps is configured with concurrent gaps, the carrier specific scaling factor is calculated separately for each gap pattern, [provided that the association between measurement objects and gap pattern is configured by network. Only the measurement objects associated to the same measurement gap pattern are counted when deriving CSSFwithin\_gap,I for a target measurement object with index *i*.]. In case of collision between concurrent measurement gaps, some measurement gap occasions may be dropped according to clause [9.1.X2.x]. The dropped gap occasions will not be used in deriving CSSFwithin\_gap,i.

Editor’s note: FFS whether to remove [ ] or revise the sentence in [ ] after RAN2 concludes the implementation on RRC association.

If measurement object *i* refers to a long-periodicity measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition and the CSSFwithin\_gap,i are derived as below.

Table 9.1.5.2.2-1: void

When multiple positioning frequency layers are configured,

- for each positioning frequency layer i, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer i, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-frequency SFTD measurement object, if to be measured with measurement gaps, is a candidate to be measured in all measurement gaps.

- An NR PRS-based measurement is a candidate to be measured in a gap is TBD.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurements, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT frequency layers, up to one positioning frequency layer, RSSI/CO measurements, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers and up to one NR PRS measurement on any one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object or NR PRS measurement on any one positioning frequency layer, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

CSSFwithin\_gap,k=1 during TDetect, E-UTRAN FDD specified in clause 9.4.4.1.2.2 and TDetect, E-UTRAN TDD specified in clause 9.4.4.2.2.2, where k is the carrier frequency where the UE is performing cell detection of the inter-RAT E-UTRA OTDOA assistance data reference cell when acquiring the subframe and slot timing of the cell according to clause 9.4.4. In this case, the UE cell identification and measurement periods derived based on CSSFwithin\_gap,i in clauses 9.2.5.1, 9.2.5.2, 9.2.6.2, 9.2.6.3, 9.3.4, 9.3.5, 9.4.2.2, 9.4.2.3 and 9.10.2 may be extended for measurement objects of which the cell identification and measurement periods are overlapped with TDetect, E-UTRAN FDD and TDetect, E-UTRAN TDD.

##### 9.1.5.2.3 NE-DC: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*.

If measurement object *i* refers to a long-periodicty measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition are derived as below.

When multiple positioning frequency layers are configured,

- for each positioning frequency layer *i*, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An inter-RAT measurement object is a candidate to be measured in all measurement gaps.

- An inter-frequency E-UTRA measurement object is a candidate to be measured in all measurement gaps.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j: Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects, up to one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

If the number of configured inter-frequency and inter-RAT measuerement objects and NR PRS measurements on all positioning frequency layers is zero and the UE is configured with per UE gaps:

FR1 intrafrequency measurement objects belong to group A

FR2 intrafrequency measurement objects belong to group B

MgroupA,i,j: The number of FR1 intrafrequency measurement objects Mintra-FR1,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : The number of FR2 intrafrequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is a group A measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×MgroupA,i,j) in gaps where MgroupB,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupA,i,j) in gaps where MgroupB,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an group B measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

##### 9.1.5.2.4 NR-DC: carrier-specific scaling factor for SSB-based and CSI-RS-based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*.

If measurement object *i* refers to a long-periodicity measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition and the CSSFwithin\_gap,i are derived as below.

When multiple positioning frequency layers are configured,

- for each positioning frequency layer *i*, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects and up to one NR PRS measurement on any one positioning frequency layer belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects and up to one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is zero and the UE is configured with per UE gaps:

FR1 intrafrequency measurement objects belong to group A

FR2 intrafrequency measurement objects belong to group B

MgroupA,i,j: The number of FR1 intrafrequency measurement objects Mintra-FR1,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : The number of FR2 intrafrequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is a group A measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×MgroupA,i,j) in gaps where MgroupB,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupA,i,j) in gaps where MgroupB,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an group B measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1

Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

##### 9.1.5.2.5 SA mode: carrier-specific scaling factor for PRS-based measurements performed within gaps

The requirements in this clause apply for NR PRS-based measurements for positioning in clause 9.9.

When NR PRS-based measurements for positioning are configured on one or more positioning frequency layers within measurement gaps, the carrier specific scaling factor for a target PRS-based positioning measurement on a positioning frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in clause 9.1.5.2.2.

NR Positioning measurement requirements for long periodicity measurements apply in case all PRS resources in the PFL are configured with periodicity > 160 ms.

##### 9.1.5.2.6 NE-DC: carrier-specific scaling factor for PRS-based measurements performed within gaps

The requirements in this clause apply for NR PRS-based measurements for positioning in clause 9.9.

When NR PRS-based measurements for positioning are configured on one or more positioning frequency layers within measurement gaps, the carrier specific scaling factor for a target measurement on a positioning frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in clause 9.1.5.2.3.

NR Positioning measurement requirements for long periodicity measurements apply in case all PRS resources in the PFL are configured with periodicity > 160 ms.

##### 9.1.5.2.7 NR-DC: carrier-specific scaling factor for PRS-based measurements performed within gaps

The requirements in this clause apply for NR PRS-based measurements for positioning in clause 9.9.

When NR PRS-based measurements for positioning are configured on one or more positioning frequency layers within measurement gaps, the carrier specific scaling factor for a target measurement on a positioning frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in clause 9.1.5.2.4.

NR Positioning measurement requirements for long periodicity measurements apply in case all PRS resources in the PFL are configured with periodicity > 160 ms.

#### 9.1.5.3 Monitoring of multiple layers within NCSG

The measurement requirements derived from CSSFwithin\_ncsg,i defined in this clause are applicable provided that network provides NCSG pattern for measurement.

The carrier-specific scaling factor CSSFwithin\_ncsg,i for a measurement object *i* derived in this clause is applied to following measurement types:

- SSB-based intra-frequency measurement object without measurement gap as defined in clause 9.2.1 corresponding to an activated serving cell, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the NCSG;

- SSB-based intra-frequency measurement object with NCSG as defined in clause 9.2.1 corresponding to an activated serving cell (in non-dormancy);

- SSB-based intra-frequency measurement object corresponding to a deactivated serving cell or to an activated serving cell in dormancy, when all or part of the SMTC occasions of this intra-frequency measurement object are overlapped by the NCSG;

- SSB-based inter-frequency measurement object without measurement gap as defined in clause 9.3.1, when all of the SMTC occasions of this inter-frequency measurement object are overlapped by the NCSG;

- SSB-based inter-frequency measurement object with NCSG as defined in clause 9.3.1;

- E-UTRA inter-RAT measurement object, when the measurement can be performed with no measurement gap but NCSG as defined in clause [*TBD*];

UE is expected to conduct the measurement of this measurement object *i* only within the NCSG.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present for an intra-frequency measurement object, and *smtc1* is fully overlapping with NCSG and *smtc2* is partially overlapping with NCSG, requirements derived from CSSFwithin\_ncsg,i and CSSFoutside\_gap,i are not applicable.

##### 9.1.5.3.1 SA mode: carrier-specific scaling factor for measurements performed within NCSG

When one or more measurement objects are monitored within NCSG, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_ncsg,i and is derived as described in this clause.

For each NCSG occasion *j*, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the occaison *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in an NCSG occasion if its SMTC duration is fully covered by the ML. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An inter-RAT E-UTRA measurement object configured is a candidate to be measured in all NCSG occasions.

- Mintra,i,j: Number of intra-frequency measurement objects which are candidates to be measured in NCSG occasion *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency measurement objects and E-UTRA inter-RAT measurement objects which are candidates to be measured in NCSG occasion *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT measurement objects which are candidates to be measured in NCSG occasion *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For UEs which support and are configured with per FR NCSG, the above counting is done on a per FR basis, and for UEs which are configured with per UE NCSG the counting is done on a per UE basis.

The carrier specific scaling factor CSSFwithin\_ncsg,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_ncsg,i= max(Mtot,i,j), where *j*=0…(160/VIRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_ncsg,i is the maximum among

- ceil(Kintra×Mintra,i,j) in NCSG occasions where Minter,i,j≠0, where *j*=0…(160/VIRP)-1

- Mintra,i,j in NCSG occasions where Minter,i,j=0, where *j*=0…(160/VIRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_ncsg,i is the maximum among

- ceil(Kinter×Minter,i,j) in NCSG occasions where Mintra,i,j ≠0, where *j*=0…(160/VIRP)-1

- Minter,i,j in NCSG occasions where Mintra,i,j=0, where *j*=0…(160/VIRP)-1

### 9.1.6 Minimum requirement at transitions

When the measurement on one intra-frequency measurement object transitions from measurements performed outside gaps to measurements performed within gaps or vice versa during one measurement period, the cell identification and measurement period requirements with the longer delay apply.

The carrier-specific scaling factor specified in clause 9.1.5 that applies to the other impacted measurement objects will also apply based on the longer measurement or cell identification delay before or after the transition.

When the UE transitions between DRX and non-DRX or when DRX cycle periodicity changes, the cell identification and measurement period requirements apply based on the longer delay before or after the transition.

Subsequent to this measurement period, the cell identification and measurement period requirements on each measurement object are corresponding to the second mode after transition.

### 9.1.7 Pre-configured measurement gap

#### 9.1.7.1 Introduction

A UE capable of Pre-configured measurement gap (Pre-MG) pattern can be configured with a Pre-MG pattern via RRC signalling [2].

The gap interruption requirements in Section 9.1.2 apply to Pre-MG when Pre-MG is activated, and no gap interruption is expected when Pre-MG is deactivated.

- The requirements apply for NR standalone operation with single carrier and NR CA.

#### 9.1.7.2 Requirements applicability

The requirements related to pre-configured measurement gap apply provided:

- UE indicates support of *preconfiguredUE-AutonomousMeasGap* [2] and/or *preconfiguredNW-ControlledMeasGap* [2], and

- either a single per-UE measurement gap is pre-configured by the network, or one or two per-FR measurement gaps are pre-configured by the network, and

- one of measurement gap patterns among measurement gap patterns #0 ~ #25 is configured for pre-configured measurement gap, and

- UE is in NR SA with single carrier or with NR CA.

A measurement gap is configured as pre-configured measurement gap if *preConfigInd* is indicated by network in the configuration message of the measurement gap.

If UE indicates support of only *preconfiguredNW-ControlledMeasGap* [2], UE can expect the network to configure *preConfGapStatus*.

If a measurement gap is configured as pre-configured measurement gap, the applicability of measurement gap patterns is defined in Table 9.1.2-3.

When a pre-configured measurement gap is used to perform PRS measurements, the UE will inform the network that it is going to start/stop PRS measurements with the configured pre-configured measurement gap by initiating the existing *LocationMeasurementIndication* procedure.

If the Pre-MG status changes during a measurement period of a measurement that can be performed without and within measurement gaps, the UE is allowed to restart the measurement.

If the Pre-MG status changes from activated to deactivated during a measurement period of a measurement that can only be performed within measurement gaps, the measurement requirements do not apply.

#### 9.1.7.3 Requirements

Any of the measurement Gap pattern #0 to #25 defined in Table 9.1.2-1 can be configured as Pre-MG pattern.

The UE can determine the Pre-MG status based on autonomous activation/deactivation mechanism or based on network-controlled activation/deactivation mechanism.

A UE capable of both autonomous and network-controlled mechanisms for activation/deactivation of Pre-MG pattern will not use autonomous rules to determine the activation/deactivation status of the pre-configured MG if the network provides the activation/deactivation status via RRC indication *preConfGapStatus* for all the DL BWPs of all the activated CCs, and for all the deactivated SCCs.

##### 9.1.7.3.1 Requirements for autonomous activation/deactivation mechanism

Requirements in this section apply when autonomous mechanism [2] is used for activation/deactivation of Pre-MG pattern.

The UE can autonomously change the Pre-MG status from activation to deactivation or vice versa based on any of the following triggering conditions listed below. The UE shall also autonomously determine the Pre-MG status based on all the concurrent triggering conditions occurring jointly:

- DCI, timer or RRC based active BWP switching,

- Activation/deactivation of SCell(s),

- Addition/removal of any measurement object(s)

- Addition/release/change of a SCell in carrier aggregation,

The UE shall autonomously determine the status of the per-UE Pre-MG pattern as deactivated immediately after the configuration of the per-UE Pre-MG pattern or when any of the triggering conditions above is satisfied provided that all the configured measurements can be performed without measurement gaps. The UE shall autonomously determine the status of the per-FR Pre-MG pattern as deactivated immediately after the configuration of the per-FR Pre-MG pattern or when any of the triggering conditions above is satisfied provided that all the configured measurements in the same FR can be performed without measurement gaps.

A measurement can be performed by the UE without measurement gaps if any of the following conditions is met:

- The UE is configured with SSB based intra-frequency measurements, and the conditions defined for SSB based intra-frequency measurement without gaps in Clause 9.2.1 are met, or

- The UE is configured with SSB based inter-frequency measurements, and the conditions defined for SSB based inter-frequency measurement without gaps in Clause 9.3.1 are met, or

- The UE is configured with CSI-RS based intra-frequency measurements.

The UE shall autonomously determine the status of the per-UE Pre-MG pattern as activated immediately after the configuration of the per-UE Pre-MG pattern or when any of the triggering conditions above is satisfied provided that at least one of the configured measurements cannot be performed without measurement gaps. The UE shall autonomously determine the status of the per-FR Pre-MG pattern as activated immediately after the configuration of the per-FR Pre-MG pattern or when any of the triggering conditions above is satisfied provided that at least one of the configured measurements in the same FR cannot be performed without measurement gaps.

A measurement cannot be performed by the UE without measurement gaps if any of the following conditions is met:

- The UE is configured with SSB based intra-frequency measurements, and the conditions defined for SSB based intra-frequency measurement without gaps in Clause 9.2.1 are not met, or

- The UE is configured with SSB based inter-frequency measurements, and the conditions defined for SSB based inter-frequency measurement without gaps in Clause 9.3.1 are not met, or

- The UE is configured with any of the following measurements:

- CSI-RS based inter-frequency measurements, or

- E-UTRA Inter-RAT measurements, or

- UTRA Inter-RAT measurements.

##### 9.1.7.3.2 Requirements for network-controlled activation/deactivation mechanism

The requirements in this section apply when network-controlled mechanism [2] is used for activation/deactivation of Pre-MG pattern.

For per-UE Pre-configured MG,

- the UE determines that the Pre-configured MG is activated if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for the active DL BWP of any of the activated CCs, or if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for any of the deactivated SCCs,

- otherwise, the UE determines that the Pre-configured MG is deactivated

For per-FR Pre-configured MG,

- the UE determines that the Pre-configured MG is activated if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for the active DL BWP of any of the activated CCs in the corresponding FR, or if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for any of the deactivated SCCs in the corresponding FR,

- otherwise, the UE determines that the Pre-configured MG is deactivated

##### 9.1.7.3.3 Requirements for reception/transmission during activation/deactivation

The requirements in this section apply when autonomous mechanism or network-controlled mechanism is used for activation/deactivation [2] of Pre-MG pattern.

If per-UE Pre-MG pattern is activated then the UE is not required to conduct reception/transmission from/to the corresponding serving cells during the gap occasion according to the same principles as described for per-UE measurement gaps in clause 9.1.2. Otherwise, the UE can be scheduled for reception/transmission of signals in all the serving cells during the gap occasion.

If per-FR Pre-MG pattern is activated then the UE is not required to conduct reception/transmission from/to the corresponding serving cells during the gap occasion on the same FR according to the same principles as described for per-FR measurement gaps in clause 9.1.2. Otherwise, the UE can be scheduled for reception/transmission of signals in all the serving cells during the gap occasion in the same FR.

### 9.1.8 Concurrent measurement gaps

#### 9.1.8.1 Introduction

When UE supports concurrent measurement gap pattern capability, network can provide multiple measurement gaps configured by RRC message(s) as specified in TS 38.331 [2]. Requirements in this section applies when the UE is in SA operation mode.

#### 9.1.8.2 Requirements

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports *concurrentPerUE-OnlyMeasGap-r17* as specified in [14], in order for the requirements in the following clauses to apply, the network can provide at most two per-UE measurement gap patterns for monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports *concurrentPerUE-PerFRCombMeasGap-r17* as specified in [14], in order for the requirements defined for concurrent measurement gaps to apply, the network can provide the measurement gap pattern combinations specified in Table 9.1.8-1 for monitoring of all frequency layers.

Table 9.1.8-1: The number of Gap Combination Configurations by UE supporting both concurrent measurement gap patterns and independent measurement gap patterns

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Combination  Configuration Id | The number of simultaneous configured measurement gap patterns | | |
| Per-FR1 measurement gap | Per-FR2 measurement gap | Per-UE measurement gap |
| 0 | 2 | 1 | 0 |
| 1 | 1 | 2 | 0 |
| 2 | 0 | 0 | 2 |
| 3Note 1 | 1 | 0 | 1 |
| 4Note 1 | 0 | 1 | 1 |
| 5Note 1 | 1 | 1 | 1 |
| 6 | 2 | 0 | 0 |
| 7 | 0 | 2 | 0 |
| Note 1: Gap Combination Configuration Id #3, #4, #5 will be only applied when the per-UE measurement gap is associated to measure PRS for any RSTD, PRS-RSRP, and UE Rx-Tx time difference measurement defined in TS 38.215 [4].  Note 2: In Gap Combination Configuration Id #0, #1, #6, #7, one per-FR measurement gap in an FR can be associated to measure PRS for any RSTD, PRS-RSRP, and UE Rx-Tx time difference measurement defined in TS 38.215 [4] provided that UE supports *independentGapConfigPRS-r17*. | | | |

For UE configured in the SA operation mode, when monitoring of multiple inter-RAT E-UTRAN carrier frequency layers and inter-frequency NR carrier frequency layers as configured by PCell using gaps, each monitored carrier frequency layer, including following measurement types:

- a measurement object with SSB based measurement,

- a measurement object with CSI-RS based measurement,

- E-UTRA inter-RAT measurement object,

- E-UTRAN inter-RAT RSTD measurement,

- NR PRS-based positioning measurements,

can be only associated to one measurement gap pattern. Requirements for concurrent measurement gaps apply provided that each frequency layer is only associated with one concurrent measurement gap. There can be one or more frequency layers associated with each concurrent measurement gap. Furthermore, when only E-UTRAN measurement objects are configured for the UE, if the UE is not capable of concurrentMeasGapEUTRA-r17[2], all E-UTRAN measurement objects are expected to be associated with a single concurrent gap pattern.

*Editor Notes: Whether all E-UTRAN measurement objects are expected to be associated with a single concurrent gap pattern or not when both E-UTRAN measurement objects and other type of measurements are configured for the UE, still FFS.*

When UE supports concurrent measurement gap patterns, each measurement gap pattern supported by the UE is listed in Table 9.1.2-1 based on the applicability specified in table 9.1.2-3.

The requirements in clause 9.1.2 are also applicable for the UE capable of and configured with multiple concurrent measurement gap patterns within each measurement gap pattern.

When UE supports concurrent measurement gap patterns and configured with more than 1 measurement gap pattern Per FR or Per-UE according to table 9.1.8-1, requirements does not apply if the UE is configured with more than one measurement gap pattern (MGP) with measurement gap repetition period (MGRP) of 20ms in an FR.

#### 9.1.8.3 Collision between concurrent measurement gaps

Collisions between occasions of two concurrent measurement gaps may occur as specified in this clause if the two measurement gaps are

- two per-UE measurement gaps, or

- two per-FR measurement gaps in the same FR, or

- one per-UE measurement gap and one per-FR measurement gap.

When UE is configured with concurrent measurement gaps, two measurement gap occasions are considered colliding if at least one of the following conditions is met:

- the two occasions are fully or partially overlapping in time domain, or

- the distance between the two occasions is equal to or smaller than 4ms.

The distance between two measurement gap occasions is defined as the time difference between the ending point of the first occasion and the starting point of the second occasion, where the first measurement gap occasion occurs earlier in time than the second measurement gap occasion.

In case of collision between two measurement gap occasions, the UE shall perform measurements in the occasion of the measurement gap with higher priority, and the occasion of the measurement gap with lower priority shall be dropped. The UE shall be able to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI in the corresponding NR serving cells in the slots that are not interrupted according to requirements in clause 9.1.8.4.

The requirements of concurrent measurement gaps in section 9 shall not apply when a gap without assigned priority is configured simultaneously with any other gap(s) that affect serving carriers in the same FR and the measurement gaps are colliding with each other.

The priority for a measurement gap is configured by networks via *gapPriority* in *GapConfig*. The requirements with concurrent measurement gaps apply provided that two measurement gaps colliding with each other are configured with different priorities.

#### 9.1.8.4 Measurement gap related requirements of concurrent measurement gaps

A slot is considered as interrupted if it is interrupted by an occasion of any of the configured concurrent measurement gaps following the measurement gap interruption requirements in clause 9.1.2, except for a dropped measurement gap occasion.

### 9.1.9 Network controlled small gap

#### 9.1.9.1 Introduction

The UE capable of network controlled small gap (NCSG) pattern can be configured with a NCSG pattern via RRC signalling [2].

This clause contains the general requirements on the UE regarding to Network Controlled Small Gap (NCSG).

The requirements in this clause are applicable for UE configured with SA NR (with single carrier or NR CA) operation mode.

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

- when *mgta* is not applied, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the last each of the interrupted slots after VIL1 and VIL2.

- when *mgta* is applied and the SCS of the UL carrier is other than 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the last each of the interrupted slots after VIL1 and VIL2.

- when *mgta* is applied and the SCS of the UL carrier is 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the slot partially overlapped with each of the interrupted slots after VIL1 and VIL2.

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

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

The interruptions of NCSG in number of slots are listed in Table 9.1.9-1 on all serving cells when per-UE NCSG is configured or on FR1 serving cells when per-FR FR1 NCSG is configured to *ncsg-MeasGapPerFR-r17* capable UE. In case that the UE capable of *ncsg-MeasGapPerFR-r17* is configured with per-FR FR2 NCSG, numbers of interrupted slots on FR2 serving cells are listed in Table 9.1.9-2. There are two interruptions in each NCSG occasion, VIL1 before ML and VIL2 after ML, in NR standalone (with single carrier or NR CA). Each of them has number of interrupted slots captured in Table 9.1.9-1 and Table 9.1.9-2.

Table 9.1.9-1: Number of interrupted slots on all serving cells for per-UE NCSG or FR1 serving cells for FR1 NCSG during each VIL in NR standalone operation (with single carrier, NR CA)

|  |  |
| --- | --- |
| NR | Number of interrupted slots on serving cells |
| SCS | When MG timing advance of 0ms is applied |
| (kHz) | VIL=1ms |
| 15 | 1 |
| 30 | 2 |
| 60 | 4 |
| 120 | 8 |
| NOTE 1: NR SCS of 120 kHz is only applicable to the case with per-UE NCSG.  NOTE 2: Void | |

**Table 9.1.9-2: Number of interrupted slots on FR2 serving cells for FR2 NCSG during each VIL in NR standalone operation (with single carrier, NR CA)**

|  |  |  |
| --- | --- | --- |
| NR | Number of interrupted slots on serving cells | |
| SCS | When MG timing advance of 0ms is applied | When MG timing advance of 0.75ms is applied |
| (kHz) | VIL=0.75ms | VIL=0.75ms |
| 60 | 3 | 3 |
| 120 | 6 | 6 |
| NOTE 1: Void | | |

#### 9.1.9.2 Requirements applicability

Requirements in clause 9.1.9 apply for UE capable of NCSG in standalone NR in both FR1 and FR2 (including FR1+FR2 CA), provided UE is configured with only NCSG and no other measurement gap is configured, and UE is configured with

SSB based intra-frequency measurement (including measurement on de-activated SCC and measurement on dormant SCell), and/or

SSB based inter-frequency measurement, and/or

Inter-RAT E-UTRAN measurement.

Requirements for the following measurements do not apply if UE is configured with NCSG.

Inter-RAT GSM measurement, or

Inter-RAT UTRAN measurement, or

PRS measurement.

9.1.9.3 Requirements

The UE shall support NCSG patterns defined in Table 9.1.9.3-1 that are relevant to the UE’s measurement capabilities. ML is the measurement length. During the VIL1 and VIL2, the UE is not expected to transmit and receive any data. Where, VIL1 is the visible interruption length before the ML and VIL2 is the visible interruption length after the ML. During ML, whether the UE is expected to transmit and receive data on the corresponding serving carrier(s) depends on the scheduling restriction requirements specified in clauses 9.2.7.3 and 9.3.10.3. The NCSG configuration parameters VIL1, ML, VIL2 and VIRP are illustrated in Figure 9.1.9.3-1. The applicability of the NCSG patterns in Table 9.1.9.3-1 is specified in Table 9.1.9.3-2.

**VIL1**

**VIL2**

**ML**

**…**

**…**

**VIL1**

**VIL2**

**Time**

**VIRP**

**ML**

**Figure 9.1.9.3-1: Illustration of NCSG configuration parameters: VIL1, ML, VIL2 and VIRP**

Table 9.1.9.3-1: NCSG Configurations supported by the UE

|  |  |  |
| --- | --- | --- |
| NCSG Pattern Id | Measurement Length during which there is no gap (ML, ms) | Visible interruption Repetition Period  (VIRP, ms) |
| 0 | 5 | 40 |
| 1 | 5 | 80 |
| 2 | 2 | 40 |
| 3 | 2 | 80 |
| 4 | 5 | 20 |
| 5 | 5 | 160 |
| 6 | 3 | 20 |
| 7 | 3 | 40 |
| 8 | 3 | 80 |
| 9 | 3 | 160 |
| 10 | 2 | 20 |
| 11 | 2 | 160 |
| 12 | 5 | 20 |
| 13 | 5 | 40 |
| 14 | 5 | 80 |
| 15 | 5 | 160 |
| 16 | 3 | 20 |
| 17 | 3 | 40 |
| 18 | 3 | 80 |
| 19 | 3 | 160 |
| 20 | 1 | 20 |
| 21 | 1 | 40 |
| 22 | 1 | 80 |
| 23 | 1 | 160 |

Table 9.1.9.3-2: Applicability for NCSG pattern configurations supported by the UE for NR standalone operation with single carrier or NR CA configuration

|  |  |  |  |
| --- | --- | --- | --- |
| NCSG pattern configuration | Serving cell | Measurement Purpose NOTE 2 | Applicable NCSG Pattern Id |
|  | FR1, or  FR1 + FR2 | E-UTRA | 0,1,2,3 |
|  |  | FR1 and/or FR2 | 0-11, 24 |
|  |  | E-UTRA and FR1 and/or FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| Per-UE NCSG | FR2 | E-UTRA only | 0,1,2,3 |
|  |  | FR1 only | 0-11 |
|  |  | FR1 and FR2 | 0-11 |
|  |  | E-UTRA and FR1 and/or FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  |  | FR2 only | 12-23 |
|  | FR1 if configured | E-UTRA only | 0,1,2,3 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR NCSG | FR2 if configured |  | 12-23 |
|  | FR1 if configured | E-UTRA and | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR1 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | E-UTRA and | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 | 12-23 |
|  | FR1 if configured | E-UTRA and  FR1 and FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | 12-23 |
| NOTE 1: When E-UTRA inter-RAT RSTD measurements are configured and the UE requires NCSG for performing such measurements, only NCSG Pattern #0 can be used.  NOTE 2: Measurement purpose which includes E-UTRA measurements includes also inter-RAT E-UTRA RSRP and RSRQ measurements for E-CID; measurement purpose which includes E-UTRA measurements includes also E-UTRA RSRP and E-UTRA RSRQ measurements for E-CID.  NOTE 3: If per-UE NCSG is configured with MG timing advance of TMG ms, the NCSG starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured NCSG among all serving cells subframes.  If per-FR NCSG for FR1 is configured with MG timing advance of TMG ms, the NCSG for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured NCSG among serving cells subframes in FR1.  If per-FR NCSG for FR2 is configured with MG timing advance of TMG ms, the NCSG for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured NCSG among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the NCSG starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured NCSG among serving cells.  NOTE 4: For UE only supporting *ncsg-MeasGapNR-Patterns-r17* for any NCSG patterns among NCSG pattern # 2-11, the corresponding NCSG patterns are not applicable to measurement of E-UTRA. | | | |

### 9.1.10 MUSIM gaps

If the UE requires gap patterns for MUSIM purpose, such as cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network, then the network may provide one or more per-UE MUSIM gap pattern(s) for concurrent monitoring of all frequency layers for MUSIM via *MUSIM-GapConfig* [2]. The UE can be configured with no more than three periodic MUSIM gap patterns and/or one aperiodic MUSIM gap pattern for MUSIM via *MUSIM-GapConfig* [2]. The MUSIM gap patterns specified in Table 9.1.10-1 are applicable only for MUSIM operation.

The UE is not required to perform cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network that is outside the MUSIM gaps.

UE supporting MUSIM capability shall support the MUSIM gap patterns listed in Table 9.1.10-1 based on UE’s capability specified in TS38.306[14] and the applicability specified in Table 9.1.10-2.

UE determines MUSIM gap timing based on gap offset configuration from serving cell provided by higher layer signalling as specified in TS 38.331 [2].

Table 9.1.10-1: MUSIM Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| **MUSIM Gap Pattern Id** | **MUSIM Gap Length (MGL, ms)** | MUSIM Gap Repetition Period (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 10 | 80 |
| 13 | 20 | 160 |
| 14 | 6 | 320 |
| 15 | 6 | 640 |
| 16 | 6 | 1280 |
| 17 | 6 | 2560 |
| 18 | 10 | 320 |
| 19 | 10 | 640 |
| 20 | 10 | 1280 |
| 21 | 10 | 2560 |
| 22 | 20 | 320 |
| 23 | 20 | 640 |
| 24 | 20 | 1280 |
| 25 | 20 | 2560 |
| 26 | 20 | 5120 |
| 27 | 10 | NA |
| 28 | 20 | NA |
| Note 1: Measurement gap pattern #27, #28 are the aperiodic gap pattern without MGRP. | | |

Table 9.1.10-2: Applicability for MUSIM Gap Pattern Configurations supported by the UE with NR standalone operation (with single carrier, NR CA configuration)

|  |  |  |  |
| --- | --- | --- | --- |
| MUSIM gap pattern configuration | Serving cell | Gap Purpose | Applicable MUSIM Gap Pattern Id |
| Per-UE | FR1, FR2, or | MUSIM Note1 | 0-13, 14-26, 27, 28 |
| MUSIM gap | FR1 + FR2 |
|  |  |
| NOTE 1: Inclusion of MUSIM procedures for per-UE MUSIM gaps only in NR single carrier, NR CA mode: MUSIM purpose which includes cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network. | | | |

### 9.1.11 UL gap for Tx power management

The UL gap patterns for TX power management are listed in Table 9.1.11-1 if UE supports the UL gap for Tx power management, and the UE shall support at least one of UL MGP#1 and UL MGP#3. All other UL MGPs are optional.

Table 9.1.11-1: UL Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
|  | UL Gap Length (UGL) [ms] | UL gap repetition periodicity (UGRP) [ms] |
| UL MGP #0 | 1.0 | 20 |
| UL MGP #1 | 1.0 | 40 |
| UL MGP #2 | 0.5 | 160 |
| UL MGP #3 | 0.125 when SCS of active UL BWP =120kHz  0.25 when SCS of active UL BWP =60kHz | 5 |

An uplink gap consists of consecutive static UL slot(s) in one or more *TDD-UL-DL-Pattern* duration, starting from the first static UL slot of an UL gap repetition period. UGL is the aggregated length of consecutive UL slots used as the UL gap within an UL gap repetition period. That means, there can be a DL slot and/or special slot but no static UL slot between the two consecutive static UL slots within the UL gap length.

When an UL gap overlaps with an uplink transmission in NR serving cells in FR2 single CC or FR2 intra-band CA or FR2 inter-band CA where UE does not support tx-Support-UL-GapFR2-r17, then the UE is not required to conduct any transmission during the UL gap on the NR serving cells other than those listed in Clause 5.30 in TS 38.321 [7].

## 9.1A General measurement requirement for RedCap

### 9.1A.1 Introduction

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

The SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified.

### 9.1A.2 Measurement gap

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

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

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

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

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

Table 9.1A.2-1: Gap Pattern Configurations

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement Purpose | Applicable Gap Pattern Id |
|  | FR1 | non-NR RAT NOTE2 | 0,1,2,3 |
|  |  | FR1 and/or FR2 | 0-11 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| Per-UE measurement | FR2 | non-NR RATonly  NOTE2 | 0,1,2,3 |
| gap |  | FR1 only | 0-11 |
|  |  | FR1 and FR2 | 0-11 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  |  | FR2 only | 12-23 |
|  | FR1 if configured | non-NR RATonly | 0,1,2,3 |
|  | FR2 if configured | NOTE2 | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| gap | FR2 if configured | FR1 NOTE2 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 NOTE2 | 12-23 |
|  | FR1 if configured | non-NR RATand  FR1 and FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | 12-23 |
| NOTE1: If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among all serving cells subframes.  If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR1.  If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the measurement gap starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured measurement gap among serving cells.  NOTE 2: In RedCap, non-NR RAT means E-UTRA only.  NOTE 3: For UE only supporting *supportedGapPattern-NRonly* for any gap patterns among GP2-11, the corresponding gap patterns are not applicable to measurement of non-NR RAT as defined in NOTE 2. | | | |

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

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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

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

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

### 9.1A.3 UE Measurement capability

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

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

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

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

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

where

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

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

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

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

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

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

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

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

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

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

#### 9.1A.4.1 Introduction

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

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

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

#### 9.1A.4.2 Requirements

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

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

- For UE configured with SA operation mode: , where

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

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

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

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

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

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

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

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

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

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

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3B.7, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause [9.3B.7], when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

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

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

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFoutside\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

##### 9.1A.5.1.1 SA mode: carrier-specific scaling factor for SSB-based measurements performed outside gaps

For UE in SA operation mode, the carrier-specific scaling factor CSSFoutside\_gap\_RedCap,i for intra-frequency SSB-based measurements, inter-frequency SSB-based measurements performed outside measurements gaps, will be specified as follows:

CSSFoutside\_gap,i =1, if only one measurement object is configured to be measured outside of MG for RedCap.

CSSFoutside\_gap,i =2 for intra-frequency measurement, and CSSFoutside\_gap,i = 2\*Y for inter-frequency measurement with no measurement gap, Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG.

If intra-frequency measurement is with measurement gap, CSSFoutside\_gap,i = Y for inter-frequency measurement with no measurement gap, Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG.

#### 9.1A.5.2 Monitoring of multiple layers within gaps

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

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

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2B.6.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3B.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3B.7, when

-all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network- E-UTRA Inter-RAT measurement object in clauses 9.4A.2 and 9.4A.3.

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

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

##### 9.1A.5.2.1 SA mode: carrier-specific scaling factor for SSB measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap\_RedCap,i and is derived as described in this clause.

For each measurement gap *j* count the total number of intra-frequency measurement object and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement object, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra\_RedCap,i,j: Number of intra-frequency measurement objects, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter\_RedCap,i,j : Number of NR inter-frequency layers and EUTRA inter-RAT, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter\_RedCap,i,j equals 0.

- Mtot\_RedCap,i,j = Mintra\_RedCap,i,j + Minter\_RedCap,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot\_RedCap,i,j equals 0.

The carrier specific scaling factor CSSFwithin\_gap\_RedCap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap\_RedCap,i= max(ceil(Ri×Mtot\_RedCap,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Kintra×Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Kinter×Minter\_RedCap,i,j) in gaps where Mintra\_RedCap,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Minter\_RedCap,i,j)in gaps where Mintra\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

### 9.1A.6 Minimum requirement at transitions

When the measurement on one intra-frequency measurement object transitions from measurements performed outside gaps to measurements performed within gaps or vice versa during one measurement period, the cell identification and measurement period requirements with the longer delay apply.

The carrier-specific scaling factor specified in clause 9.1A.5 that applies to the other impacted measurement objects will also apply based on the longer measurement or cell identification delay before or after the transition.

When the UE transitions between DRX and non-DRX or when DRX cycle periodicity changes, the cell identification and measurement period requirements apply based on the longer delay before or after the transition.

When the intra-frequency measurement transitions from measurements performed on CD-SSB to measurements performed on NCD-SSB or vice versa due to BWP switching during one cell identification period, the UE shall use a cell identification period that is the maximum of the cell identification periods corresponding to the first SSB type and the second SSB type after the BWP switching.

When the intra-frequency measurement transitions from measurements performed on CD-SSB to measurements performed on NCD-SSB or vice versa due to BWP switching during one measurement period, the UE shall use a measurement period that is the maximum of the measurement periods corresponding to the first SSB type and the second SSB type after the BWP switching.

When the measurement on one measurement object transitions from inter-frequency measurement to intra-frequency measurement or vice versa due to BWP switching during one cell identification period, the UE shall use a cell identification period that is the maximum of the cell identification periods corresponding to the first SSB type and the second SSB type after the BWP switching.

When the measurement on one measurement object transitions from inter-frequency measurement to intra-frequency measurement or vice versa due to BWP switching during one measurement period, the UE shall use a measurement period that is the maximum of the measurement periods corresponding to the first SSB type and the second SSB type after the BWP switching .

Subsequent to the above-mentioned measurement periods and/or cell identification periods, the cell identification and measurement period requirements on each measurement object are based on the SSB type after the BWP switch.

## 9.1C General measurement requirement

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

### 9.1C.1 Introduction

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

In the requirements of clause 9, the exceptions for side conditions apply as follows:

- for the UE configured with only PCell, which is served by SAN, the applicable exceptions for side conditions are specified in Annex B, clause [B.3.x.x] for UE supporting satellite access operation.

### 9.1C.2 Measurement gap

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

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

For the UE configured with only PCell, which is served by SAN, if the UE requires measurement gaps to identify and measure cells operating in satellite access network and/or TN cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide at most [N] per-UE measurement gap pattern for concurrent monitoring of all frequency layers

During the per-UE measurement gaps the UE:

- is not required to conduct reception/transmission from/to the PCell except the reception of signals used for RRM measurement(s) and the signals used for random access procedure according to [7].

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

Table 9.1C.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |



(a) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for NR standalone operation configured with only single carrier



(b) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for NR standalone operation configured with only single carrier

Figure 9.1C.2-1: Measurement GAP and total interruption time for NR standalone operation confgigured with only single carrier

The corresponding total number of interrupted slots on PCell is listed in Table 9.1C.2-2 for NR standalone configured with only single carrier.

Table 9.1C.2-2: Total number of interrupted slots on PCell in NR standalone operation configured with only single carrier

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.5ms is applied | | | | |
| (kHz) | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 20 | 10 | 6 | 4 | 3 | 21Note3 | 11Note3 | 7Note3 | 5Note3 | 4Note3 |
| 30 | 40 | 20 | 12 | 8 | 6 | 40 | 20 | 12 | 8 | 6 |
| 60 | 80 | 40 | 24 | 16 | 12 | 80 | 40 | 24 | 16 | 12 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on MCG is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: Non-overlapped half-slots occur before and after the measurement gap. Whether a UE can receive and/or transmit in those half-slots is up to UE implementation. | | | | | | | | | | |

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

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

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

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

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

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

### 9.1C.8 Concurrent measurement gaps for SAN

#### 9.1C.8.1 Introduction

When UE supports concurrent measurement gap pattern capability, network can provide multiple measurement gaps configured by RRC message(s) as specified in TS 38.331 [2].

#### 9.1C.8.2 Requirements

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells, and the UE supports concurrent measurement gap patterns (*parallelMeasurementGap*), in order for the requirements in the following clauses to apply the network can provide at most two per-UE measurement gap patterns for monitoring of all frequency layers.

For UE configured with the SA operation, when monitoring of multiple inter-frequency NR carrier frequency layers as configured by PCell using gaps, each monitored carrier frequency layer, including following measurement types:

- a measurement object with SSB based measurement,

can be associated to one or two measurement gap pattern provided the network configures the concurrent measurement gap patterns.

When UE supports concurrent measurement gap patterns, each measurement gap pattern supported by the UE is listed in Table 9.1.2-1 based on the applicability specified in table 9.1.2-3.

The requirements in clause 9.1.2 are also applicable for the UE capable of and configured with multiple concurrent measurement gap patterns within each measurement gap pattern.

#### 9.1C.8.3 Collision between concurrent measurement gaps

Collisions between occasions of two concurrent measurement gaps may occur as specified in this clause if the two measurement gaps are

- two per-UE measurement gaps, or

When UE is configured with concurrent measurement gaps, two measurement gap occasions are considered colliding if at least one of the following conditions is met:

- the two occasions are fully or partially overlapping in time domain, or

- the distance between the two occasions is [equal to or] smaller than 4ms.

The distance between two measurement gap occasions is defined as the time difference between the ending point of the first occasion and the starting point of the second occasion, where the first measurement gap occasion occurs earlier in time than the second measurement gap occasion.

If two colliding measurement gaps are not fully overlapping, in case of collision between two measurement gap occasions, the UE shall perform measurements in the occasion of the measurement gap with higher priority, and the occasion of the measurement gap with lower priority is considered to be dropped. The UE shall be able to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI in the corresponding NR serving cells in the slots that are not interrupted according to requirements in clause 9.1C.8.4.

If two colliding measurement gaps are fully overlapping with MGRP=160ms, in case of collision between two measurement gap occasions, the UE shall perform measurements in the occasion of one of the measurement gaps, and it is up to UE implementation which occasion is used for measurement, provided that UE can meet the requirements in clause 9.2C and 9.3C.

If two measurement gaps are fully overlapping with MGRP<160ms, no measurement requirements apply.

#### 9.1C.8.4 Measurement gap related requirements of concurrent measurement gaps

A slot is considered as interrupted if it is interrupted by an occasion of any of the configured concurrent measurement gaps following the measurement gap interruption requirements in clause 9.1.2, except for a dropped measurement gap occasion.

### 9.1C.9 Collision between SMTC and measurement gap for SAN

#### 9.1C.9.1 Introduction

This clause contains definition of collision between SMTCs and measurement gap for SAN.

#### 9.1C.9.2 Collision between SMTCs and measurement gap

Collision between occasions of SMTC and measurement gap may occur as specified in this clause.

When UE is configured with one or more than one measurement gap pattern, an SMTC occasion outside measurement gap and a measurement gap occasion are considered colliding if at least one of the following conditions is met:

- the SMTC occasion is fully or partially overlapping in time domain with the measurement gap occasion, or

- the magnitude of the distance between the SMTC occasion and the measurement gap occasion in time domain is less than or equals to 4ms.

The distance between a SMTC occasion and a measurement gap occasion is defined as:

- the time difference between the ending point of the SMTC occasion and the starting point of the measurement gap occasion, where the SMTC occasion occurs earlier in time than the MG occasion, or

- the time difference between the ending point of the measurement gap occasion and the starting point of the SMTC occasion, where the measurement gap occasion occurs earlier in time than the SMTC occasion.

#### 9.1C.9.3 Collision between multiple SMTCs on a SAN carrier

Collision between occasions of multiple SMTCs may occur as specified in this clause.

When UE is configured with more than one SMTC on a SAN carrier, two SMTC occasions outside measurement gap are considered colliding if at least one of the following conditions is met:

- the two SMTC occasions are fully or partially overlapping in time domain, or

- the magnitude of the distance between two SMTC occasions in time domain is less than or equals to 4 ms.

The distance between two SMTC occasions is defined as the time difference between the ending point of the earlier SMTC occasion and the starting point of the later SMTC ocasssion.

## 9.2 NR intra-frequency measurements

### 9.2.1 Introduction

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

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

The UE can perform intra-frequency SSB based measurements without measurement gaps (either legacy measurement gap or NCSG) if

- the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement, or

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For UE supporting *nr-NeedForGapNCSG-reporting-r17* and indicating *NeedForGapNCSG-InfoNR* for intra-frequency measurement,

- An intra-frequency SSB measurement is defined as measurement without gap if

- the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR* for the intra-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE, and

- the active downlink BWP is not an initial BWP [3]

The delay requirements are specified in clause 9.2.5

An intra-frequency SSB measurement is defined as measurement with NCSG if

- the UE indicates ‘ncsg’ via *NeedForGapNCSG-InfoNR* for the intra-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE, and

- the active downlink BWP is not an initial BWP [3]

When network configures NCSG, the delay requirements are specified in clause 9.2.7

When network configures measurement gap, the delay requirements are specified in clause 9.2.6

- An intra-frequency SSB measurement is defined as measurement with gap if

- the UE indicates ‘gap’ via *NeedForGapNCSG-InfoNR* for the intra-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE, and

- the active downlink BWP is not an initial BWP [3]

When network configures measurement gap, the delay requirements are specified in clause 9.2.6

- The UE can perform intra-frequency SSB based measurement corresponding to a deactivated SCell or dormant SCell with NCSG.

- For intra-frequency SSB based measurements with NCSG, UE may cause scheduling restriction as specified in clause 9.2.7.3.

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2.5.3.SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB and measure RSSI of RSRQ which start earlier than the gap starting time + switching time, nor detect SSB and measure RSSI of RSRQ which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25ms for frequency range FR2.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

The measurement requirements defined for an activated SCell with a non-dormant active BWP defined in this clause shall also apply to an activated SCell with dormant BWP as active BWP.

### 9.2.2 Requirements applicability

The requirements in clause 9.2 apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1.2 and 10.1.3 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7 and 10.1.8 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12 and 10.1.13 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

### 9.2.3 Number of cells and number of SSB

#### 9.2.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2.3.2 Requirements for FR2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC when UE is configured with EN-DC with PSCC in the band; or

- PSCC when UE is configured with NR-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report SSB based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with SS-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least 2 SSBs on serving cell for each of the other intra-frequency layer(s) in the same band.

### 9.2.4 Measurement Reporting Requirements

#### 9.2.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

#### 9.2.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2.4.3.

#### 9.2.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index or T identify intra without index defined in clause 9.2.5.1 or clause 9.2.6.2.When L3 filtering is used an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2.5.1 or clause 9.2.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2.5.1 or clause 9.2.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

### 9.2.5 Intrafrequency measurements without measurement gaps

#### 9.2.5.1 Intrafrequency 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. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2 with SCS smaller or equal to 480 kHz.

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 9.2.5.1-1, 9.2.5.1-2, 9.2.5.1-4 (deactivated SCell) or 9.2.5.1-5 (deactivated SCell) or 9.2.5.1-9 (deactivated SCell) or 9.2.5.1-11 or 9.2.5.1-12 (deactivated PSCell) or 9.2.5.1-13 (deactivated PSCell).

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-11; otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-2.

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2.5.1-3, 9.2.5.1-15 (FR2-2), 9.2.5.1-6 (deactivated SCell), 9.2.5.1-10(deactivated SCell) or 9.2.5.1-14 (deactivated PSCell).

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2.5.2-1, table 9.2.5.2-2 table 9.2.5.2-3 (deactivated SCell), 9.2.5.2-4(deactivated SCell), 9.2.5.2-5 or 9.2.5.2-6(deactivated SCell), 9.2.5.2-8(deactivated PSCell) or 9.2.5.2-9(deactivated PSCell).

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-7; otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.

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 NCSG, 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, or according to CSSFwithin\_ncsg,i in clause 9.1.5.3 for measurement conducted within NCSG, i.e. when intra-frequency SMTC is fully overlapping with NCSG.

For a UE that supports Pre-MG, an SMTC occasion is only considered to be overlapped by Pre-MG if the Pre-MG is activated.

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*.

Mpss/sss\_sync\_w/o\_gaps: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_w/o\_gaps =40. For a UE supporting power class 2, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_w/o\_gaps = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_w/o\_gaps = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_w/o\_gaps = 36.

Mmeas\_period\_w/o\_gaps: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_w/o\_gaps =40. For a UE supporting FR2-1 power class 2, Mmeas\_period\_w/o\_gaps =24. For a UE supporting FR2-1 power class 3, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps =24. For a UE supporting FR2-2 power class 1, Mmeas\_period\_w/o\_gaps = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_w/o\_gaps = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_w/o\_gaps = 36.

MSSB\_index\_intra: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra = 72 samples. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra = 48 samples. For a UE supporting FR2 power class 3, MSSB\_index\_intra = 48 samples.

When UE supports *concurrentMeasGap-r17* and is configured with concurrent measurement gaps,

Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = 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/or per-FR measurement gap within the same FR as the SSB frequency layer, and starting from the beginning of any SMTC occasion:

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

- Navailable is the number of SMTC occasions that are not overlapped with any non-dropped MG occasion within the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3.

Kp = 1 when Navailable = 0.

- Otherwise, when UE is not configured with or UE does not support concurrent measurement gaps:

When intra-frequency SMTC is fully non overlapping with measurement gaps or NCSG, or intra-frequency SMTC is fully overlapping with MGs or NCSG, Kp=1

When intra-frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. When intra-frequency SMTC is partially overlapping with NCSG, Kp = 1/(1- (SMTC period /VIRP)), where SMTC period < VIRP. For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.* If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index

For FR2,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

If MCG DRX is in use, cell identification requirements for intra-frequency measurement in MCG specified in Table 9.2.5.1-1, Table 9.2.5.1-2, Table 9.2.5.1-3, Table 9.2.5.1-4, Table 9.2.5.1-5 and Table 9.2.5.1-6 shall depend on the MCG DRX cycle. If SCG DRX is in use, cell identification requirements for intra-frequency measurement in SCG specified in Table 9.2.5.1-1, Table 9.2.5.1-2, Table 9.2.5.1-3, Table 9.2.5.1-4, Table 9.2.5.1-5, Table 9.2.5.1-6, Table 9.2.5.1-12, Table 9.2.5.1-13 and Table 9.2.5.1-14 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

Table 9.2.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(M2 Note 2x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(5 x Kp) 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  NOTE 2: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms;,otherwise M2=1.  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 4: When *highSpeedMeasCA-Scell-r17* is configured and UE supports *measurementEnhancementCA-r17*, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1. | |

Table 9.2.5.1-2: Time period for PSS/SSS detection, (Frequency range FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_w/o\_gaps x KFR x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps x KFR x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps x KFR 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  NOTE 2: KFR is a scaling factor depending on the frequency range and the SSB SCS. For FR2-1, KFR = 1. For FR2-2: KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2.5.1-3: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (M2 Note 2 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(3 x Kp) 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  NOTE 2: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms;,otherwise M2=1  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 4: When *highSpeedMeasCA-Scell-r17* is configured and UE supports *measurementEnhancementCA-r17*, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1 | |

Table 9.2.5.1-4: Time period for PSS/SSS detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.1-5: Time period for PSS/SSS detection, deactivated SCell (FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.1-6: Time period for time index detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | Ceil(3 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(3 x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(3 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.1-7: Void

Table 9.2.5.1-8: Void

Table 9.2.5.1-9: Time period for PSS/SSS detection, deactivated SCell (FR1), when *highSpeedMeasCA-Scell-r17* is configured

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCycleSCell, M2 Note 1xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1 | |

Table 9.2.5.1-10: Time period for time index detection, deactivated SCell (FR1)，when *highSpeedMeasCA-Scell-r17* is configured

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | Ceil(3 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(3 x Kp) x max(measCycleSCell, M2 Note 1xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(3 x Kp)x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1 | |

Table 9.2.5.1-11: Time period for PSS/SSS detection when *highSpeedMeasFlagFR2-r17* is configured, (Frequency range FR2) when SMTC period <= 40ms

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | ceil(1.5x Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps Note 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  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2  NOTE 3: Void | |

Table 9.2.5.1-12: Time period for PSS/SSS detection, deactivated PSCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(5 x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

Table 9.2.5.1-13: Time period for PSS/SSS detection, deactivated PSCell (FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

Table 9.2.5.1-14: Time period for time index detection, deactivated PSCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | Ceil(3 x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(3 x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(3 x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

Table 9.2.5.1-15: Time period for time index detection (Frequency range FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(200ms, ceil(MSSB\_index\_intra x Kp x SMTC period) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5 x MSSB\_index\_intra x Kp) x max(SMTC period, DRX cycle) x CSSFintra) |
| DRX cycle>320ms | Ceil(MSSB\_index\_intra x Kp )x DRX cycle x CSSFintra |

#### 9.2.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2.5.2-1, 9.2.5.2-2, 9.2.5.2-3 (deactivated SCell), 9.2.5.2-4 (deactivated SCell), 9.2.5.2-8 (deactivated SCG applicable for PSCell) or 9.2.5.2-9 (deactivated SCG applicable for PSCell). When *highSpeedMeasFlag-r16* is configured, T SSB\_measurement\_period\_intra is specified in Table 9.2.5.2-5.

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

For a UE that supports Pre-MG, an SMTC occasion is only considered to be overlapped by Pre-MG if the Pre-MG is activated.

If MCG DRX is in use, measurement period requirements for intra-frequency measurement in MCG specified in Table 9.2.5.2-1, Table 9.2.5.2-2, Table 9.2.5.2-3 and Table 9.2.5.2-4 shall depend on the MCG DRX cycle. If SCG DRX is in use, measurement period requirements for intra-frequency measurement in SCG specified in Table 9.2.5.2-1, Table 9.2.5.2-2, Table 9.2.5.2-3, Table 9.2.5.2-4, Table 9.2.5.2-8 and Table 9.2.5.2-9, shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

For FR2, a longer measurement period is allowed, if aperiodic CSI-RS resource is measured for L1-RSRP measurement on any FR2 serving frequency in the same band, and the CSI-RS resource is outside measurement gap and overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols. If *SSB-ToMeasure* or *SS-RSSI-Measurement* is configured, the SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same band which can be merged and the RSSI symbols are indicated by *SS-RSSI-Measurement*.

Table 9.2.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp ) 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 9.2.5.2-2: Measurement period for intra-frequency measurements without gaps (FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps xKp 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 9.2.5.2-3: Measurement period for intra-frequency measurements without gaps (deactivated SCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCel | |

Table 9.2.5.2-4: Measurement period for intra-frequency measurements without gaps (deactivated SCell) (FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.2-5: T SSB\_measurement\_period\_intra When *highSpeedMeasFlag-r16* and/or highSpeedMeasCA-Scell-r17 is configured (Frequency range FR1

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX Note 2 | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 160ms | max(200ms, ceil(5 x M2 Note 2 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | ceil(4 x M2 Note 2 x Kp) x DRX cycle x CSSFintra |
| DRX cycle>320ms | ceil( Y Note 3 x Kp ) 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  NOTE 2: M2 = 1.5 if SMTC period > 40 ms, otherwise M2=1  NOTE 3: Y=3 when SMTC period <= 40ms, Y=5 when SMTC period > 40ms  NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 5: When highSpeedMeasCA-Scell-r17 is configured, the requirements apply to measurements of secondary component carrier with active SCell. | |

Table 9.2.5.2-6: Measurement period for intra-frequency measurements without gaps (deactivated SCell) (FR1), when highSpeedMeasCA-Scell-r17 is configured

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | ceil( 5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 160ms | ceil(5 x Kp) x max(measCycleSCell, M2 Note 1 x DRX cycle) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | ceil(4 x Kp) x max(measCycleSCell, M2 Note 1 x DRX cycle) |
| DRX cycle>320ms | ceil( Y Note 2 x Kp ) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 2: Y=3 when SMTC <= 40ms, Y=5 when SMTC > 40ms | |

Table 9.2.5.2-7: Measurement period for intra-frequency measurements without gaps when *highSpeedMeasFlagFR2-r17* is configured (FR2) when SMTC period <= 40ms

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(M1Note 2 x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(400ms, ceil(M1Note 2 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | ceil(1.5x Mmeas\_period\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle) x CSSFintra |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps Note 3 xKp 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  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2 | |

Table 9.2.5.2-8 Measurement period for intra-frequency measurements without gaps (deactivated SCG applicable for PSCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(5 x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

**Table 9.2.5.2-9: Measurement period for intra-frequency measurements without gaps (deactivated SCG applicable for PSCell) (FR2)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

#### 9.2.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

For a UE that supports Pre-MG, the requirements in 9.2.5.3 also apply when a Pre-MG is deactivated.

For UE supporting concurrent measurement gaps, when concurrent gaps are configured, the requirements in 9.2.5.3 are also applied to the slots that are not interrupted according to requirements in clause 9.1.X2.3.

##### 9.2.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

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

When TDD inter-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to another serving cell in a different band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this band pair.

##### 9.2.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured(in TS 38.331 [2]), the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

If the following conditions are met:

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

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

The UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and/or the corresponding PDSCH, on SSB symbols to be measured.

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

##### 9.2.5.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 intra-frequency cell

- 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 K data symbol(s) before each consecutive SSB symbols to be measured and K data symbol(s) after each consecutive SSB symbols to be measured within SMTC window duration.

- If *deriveSSB-IndexFromCell* is not enabled and the SCS of data and SSB symbols are smaller than 960kHz, 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 *deriveSSB-IndexFromCell* is not enabled and the SCS of data or SSB symbols is 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI SSB symbols to be measured, and on K’ data symbol(s) before each consecutive SSB symbols to be measured and K’ data symbol(s) after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- 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, RSSI measurement symbols, and on K data symbol(s) before each consecutive SSB to be measured/RSSI symbols and K data symbol(s) after each consecutive SSB to be measured/RSSI symbols within SMTC window duration

*-* If *deriveSSB-IndexFromCell* is not enabled and the SCS of data and SSB symbols are smaller than 960kHz, 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 *deriveSSB-IndexFromCell* is not enabled and the SCS of SSB symbols is 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on K’ data symbol(s) before each consecutive SSB to be measured/RSSI symbols and K’ data symbol(s) after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

where

- If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- The signaling *deriveSSB-IndexFromCell* is always enabled for FR2-1 and FR2-2 when SSB is using 120 kHz SCS and 480 kHz SCS.

- K=1 for a serving cell with data symbols of 120 kHz SCS

- K=4 for a serving cell with data symbols of 480 kHz SCS and SSB symbols of 120kHz or 480kHz SCS

- K=3 for a serving cell with data symbols of 480 kHz SCS and SSB symbols of 960kHz SCS

- K=7 for a serving cell with data symbols of 960 kHz SCS and SSB symbols of 120kHz or 480kHz SCS

- K=4 for a serving cell with data symbols of 960 kHz SCS and SSB symbols of 960kHz SCS

- K’=[2] for a serving cell with data symbols of 120 kHz SCS and SSB symbols of 960kHz SCS

- K’=[4] for a serving cell with data symbols of 480 kHz SCS and SSB symbols of 960kHz SCS

- K’=[7] for a serving cell with data symbols of 960 kHz SCS and SSB symbols of 960kHz SCS

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to SS-RSRP, SS-RSRQ or SS-SINR measurement on an FR2 intra-frequency cell in different bands, provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

Note: When inter-band carrier aggregation in FR2 is performed, the scheduling restrictions as defined in clause 9.2.5.3.1 due to a given serving cell should also apply to another serving cell in a different FR2 band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this FR2 band pair.

If following conditions are met:

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

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

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

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

##### 9.2.5.3.4 Scheduling availability of UE performing measurements on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to measurements performed on FR2 serving cell frequency layer. However, the scheduling restrictions as defined in clause 9.2.5.3.1 due to a given serving cell in FR2 should also apply to another serving cell in an FR1 band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this FR1-FR2 band pair.

There are no scheduling restrictions on FR2 serving cell(s) due to measurements performed on FR1 serving cell frequency layer. However, the scheduling restrictions as defined in clause 9.2.5.3.1 due to a given serving cell in FR1 should also apply to another serving cell in an FR2 band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this FR1-FR2 band pair.

#### 9.2.5.4 SFTD Measurements between PCell and PSCell

##### 9.2.5.4.1 Introduction

This clause contains SFTD measurement requirements for UE which supports NR-DC and is configured with a PSCell in RRC\_CONNECTED state. The UE shall perform SFTD measurement between PCell and PSCell, and report the SFTD result with/without SS-RSRP after the network requests with *reportType* for the associated *reportConfig* set to *reportSFTD*. The overall delay includes RRC procedure delay defined in clause 12 in TS 38.331 [2], and SFTD measurement reporting delay in clause 9.2.5.4.3..

##### 9.2.5.4.2 SFTD Measurement delay

When no DRX is used in either of PCell and PSCell, the physical layer measurement period of the SFTD measurement shall be Tmeasure\_SFTD1 = max(200, 5 x SMTC period) ms, where the SMTC period refers to the maximum between the configured SMTC period in PCell and PSCell.

When DRX is used in either of the PCell or the PSCell, or in both PCell and PSCell, the physical layer measurement period (Tmeasure\_SFTD1) of the SFTD measurement shall be as specified in Table 9.2.5.4.2-1.

Table 9.2.5.4.2-1: SFTD measurement requirement when DRX is used

|  |  |
| --- | --- |
| DRX cycle length (s) Note 3 | Tmeasure\_SFTD1 (s) |
| ≤0.04 | max(0.2, 5 x SMTC period) (Note2) |
| 0.04<DRX cycle≤0.32 | 8 x max(DRX cycle, SMTC period) |
| 0.32<DRX cycle≤10.24 | 5 x DRX cycle |
| Note 1: SMTC period in this table refers to the maximum between the configured SMTC period in PCell and PSCell.  Note 2: Number of DRX cycles depends upon the DRX cycle in use  Note 3: DRX cycle length in this table refers to the DRX cycle length configured for PCell or PSCell. When DRX is used in both PCell and PSCell, DRX cycle length in this table refers to the longer of the DRX cycle lengths for PCell and PSCell. | |

If PSCell is changed without changing carrier frequency of PSCell, while the UE is performing SFTD measurements, the UE shall still meet SFTD measurement and accuracy requirements for the new PSCell. In this case the UE shall restart the SFTD measurement, and the total physical layer measurement period shall not exceed Tmeasure\_SFTD2 as defined by the following expression:

Tmeasure\_SFTD2 = (M+1)\*(Tmeasure\_SFTD1) + M\*TPSCell\_change\_NRDC

where:

M is the number of times the NR PSCell is changed over the measurement period (Tmeasure\_SFTD2), and

TPSCell\_change\_NRDC is the time necessary to change the PSCell; it can be up to 25ms.

If PCell is changed, or if PSCell is changed with different carrier frequency from PSCell, the UE shall terminate SFTD measurements.

The measurement accuracy for the SFTD measurement when DRX is used as well as when no DRX is used shall be as specified in the clause 10.1.21.

##### 9.2.5.4.3 SFTD Measurement Reporting Delay

The SFTD measurement reporting delay is defined as the time between a command that will trigger an SFTD measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes any delay caused by no UL resources available for UE to send the measurement report.

The SFTD measurement reporting delay shall be less than measurement period defined in clause 9.2.5.4.2 plus the RRC procedure delay defined in TS 38.331 [2].

### 9.2.6 Intra-frequency measurements with measurement gaps

#### 9.2.6.1 Void

#### 9.2.6.2 Intra-frequency cell identification

When a measurement gap is provided or an activated Pre-MG is provided without any pre-MG status changed during the measurement period, 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. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2 with SCS smaller or equal to 480 kHz.

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 9.2.6.2-1, 9.2.6.2-2 or 9.2.6.2-9.

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.6.2-9; otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.6.2-2.

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2.6.2-3 or 9.2.6.2-10 (for FR2-2).

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2.6.3-1 or 9.2.6.3-2.

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.6.3-4; otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.6.3-2.

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.

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 or not supporting [concurrent measurement gaps]. 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 per-FR measurement gap within the same FR as the SSB frequency layer, 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.

When concurrent measurement gaps are configured, requirements in this clause do not apply if Navailable =0.

Mpss/sss\_sync\_with\_gaps : For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync with\_gaps=40. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync with\_gaps = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync with\_gaps = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync with\_gaps = 36.

Mmeas\_period\_ with\_gaps: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_ with\_gaps =40. For a UE supporting FR2-1 power class 2, Mmeas\_period\_ with\_gaps =24. For a UE supporting FR2-1 power class 3, Mmeas\_period\_ with\_gaps =24. For a UE supporting FR2-1 power class 4, Mmeas\_period with\_gaps =24. For a UE supporting FR2-2 power class 1, Mmeas\_period\_ with\_gaps = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_ with\_gaps = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_ with\_gaps = 36.

- MSSB\_index\_intra: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra = 72. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra = 48. For a UE supporting FR2 power class 3, MSSB\_index\_intra = 48.

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.

If MCG DRX is in use, cell identification requirements for intra-frequency measurement in MCG specified in Table 9.2.6.2-1, Table 9.2.6.2-2, and Table 9.2.6.2-3 shall depend on the MCG DRX cycle. If SCG DRX is in use, cell identification requirements for intra-frequency measurement in SCG specified in Table 9.2.6.2-1, Table 9.2.6.2-2, and Table 9.2.6.2-3 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

Table 9.2.6.2-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| 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(M2Note 1x 5 x Kgap) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil( 5 x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 3: For a UE supporting concurrent measurement gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 4: When highSpeedMeasCA-Scell-r17 is configured, the requirements apply to UE on measurements of secondary component carrier with active SCell. | |

**Table 9.2.6.2-2: Time period for PSS/SSS detection (FR2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps x KFR x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps x KFR x Kgap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | Ceil( Mpss/sss\_sync\_with\_gaps x KFR x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 2: KFR is a scaling factor depending on the frequency range and the SSB SCS. For FR2-1, KFR = 1. For FR2-2: KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2.6.2-3: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil(3 x Kgap ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(M2Note 1x 3 x Kgap) x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | Ceil(3 x Kgap )x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 3: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 4: When highSpeedMeasCA-Scell-r17 is configured, the requirements apply to UE on measurements of secondary component carrier with active SCell. | |

Table 9.2.6.2-7: Void

Table 9.2.6.2-8: Void

Table 9.2.6.2-8: Void

Table 9.2.6.2-9: Time period for PSS/SSS detection when *highSpeedMeasFlagFR2-r17* is configured, (FR2) when SMTC period <=40ms

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, M1Note 2 x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil(M1Note2 x Kgap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(600ms, ceil(Mpss/sss\_sync\_with\_gaps x Kgap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | Ceil( Mpss/sss\_sync\_with\_gaps x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2  NOTE 3: Void | |

Table 9.2.6.2-10: Time period for time index detection (Frequency range FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(200ms, ceil(MSSB\_index\_intra x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5 x MSSB\_index\_intra x Kgap) x max(MGRP, SMTC period, DRX cycle) x CSSFintra) |
| DRX cycle>320ms | Ceil(MSSB\_index\_intra x Kgap)x DRX cycle x CSSFintra |

#### 9.2.6.3 Intrafrequency Measurement Period

The requirements in this clause apply when a measurement gap is provided or when an activated Pre-MG is provided without any pre-MG status changed during the measurement period.

The measurement period for FR1 intrafrequency measurements with gaps is as shown in table 9.2.6.3-1.

The measurement period for FR2 intrafrequency measurements with gaps is as shown in table 9.2.6.3-2.

When *highSpeedMeasFlag-r16* is configured, T SSB\_measurement\_period\_intra is specified in Table 9.2.6.3-3.

If MCG DRX is in use, measurement period requirements for intra-frequency measurement in MCG specified in Table 9.2.6.3-1 and Table 9.2.6.3-2, shall depend on the MCG DRX cycle. If SCG DRX is in use, measurement period requirements for intra-frequency measurement in SCG specified in Table 9.2.6.3-1and Table 9.2.6.3-2, shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

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

Table 9.2.6.3-1: Measurement period for intra-frequency measurements with gaps(FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil(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 | Ceil(5 x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer. | |

Table 9.2.6.3-2: Measurement period for intra-frequency measurements with gaps(FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(Mmeas\_period with\_gaps x Kgap ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps x Kgap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | Ceil( Mmeas\_period with\_gaps x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer. | |

Table 9.2.6.3-3: Measurement period When *highSpeedMeasFlag-r16* is configured (Frequency Range FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kgap ) x max(MGRP, SMTC period)) Note 1 x CSSFintra |
| DRX cycle≤ 160ms | max(200ms, ceil(M2Note 2 x 5 x Kgap) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | max(200ms, ceil(M2Note 2 x 4 x Kgap) x max(MGRP, DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(Y Note 3 x Kgap ) x max(MGRP, 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  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 3: Y=3 when SMTC <= 40ms, Y=5 when SMTC > 40ms  NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 5: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 6: When highSpeedMeasCA-Scell-r17 is configured, the requirements also apply to UE on measurements of secondary component carrier with active SCell. | |

Table 9.2.6.3-4: Measurement period for intra-frequency measurements with gaps when *highSpeedMeasFlagFR2-r17* is configured (FR2) when SMTC period<=40ms

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(M1Note 2 x Kgap ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 80ms | max(400ms, ceil(M1Note 2 x Kgap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(400ms, ceil(Mmeas\_period with\_gaps x Kgap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | Ceil( Mmeas\_period with\_gaps x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2  NOTE 3: Void | |

### 9.2.7 Intra-frequency measurements with NCSG

#### 9.2.7.1 Intra-frequency cell identification

For the UE supporting NCSG, if NCSG is provided, 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. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

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 9.2.7.1-1, 9.2.7.1-2, 9.2.7.1-4 (deactivated Scell) or 9.2.7.1-5 (deactivated Scell).

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2.7.1-3 or 9.2.7.1-6 (deactivated Scell).

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2.7.2-1, 9.2.7.2-2, 9.2.7.2-3, 9.2.7.2-4 (deactivated Scell) or 9.2.7.2-5 (deactivated Scell).

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_ncsg,i in clause 9.1.5.3 for measurement conducted within NCSG.

Mpss/sss\_sync\_with\_gaps : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync with\_gaps=40. For a UE supporting FR2 power class 2, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync with\_gaps =24. For a UE supporting power class 4, Mpss/sss\_sync with\_gaps =24

Mmeas\_period\_ with\_gaps: For a UE supporting power class 1 or 5, Mmeas\_period\_ with\_gaps =40. For a UE supporting power class 2, Mmeas\_period\_ with\_gaps =24. For a UE supporting power class 3, Mmeas\_period\_ with\_gaps =24. For a UE supporting power class 4, Mmeas\_period with\_gaps =24.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with NCSG and smtc2 is partially overlapping with NCSG, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index.

Table 9.2.7.1-1: Time period for PSS/SSS detection with NCSG (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, 5 x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(M2Note 1x 5) x max(VIRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | 5 x max(VIRP, DRX cycle) x CSSFintra |
| NOTE 1: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell. | |

**Table 9.2.7.1-2: Time period for PSS/SSS detection with NCSG (FR2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps) x max(VIRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | Mpss/sss\_sync\_with\_gaps x max(VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.1-3: Time period for time index detection with NCSG (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, 3 x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(M2Note 1x 3) x max(VIRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | 3 x max(VIRP, DRX cycle) x CSSFintra |
| NOTE 1: *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell. | |

Table 9.2.7.1-4: Time period for PSS/SSS detection with NCSG (deactivated SCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | 5 x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | 5 x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | 5 x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

**Table 9.2.7.1-5: Time period for PSS/SSS detection with NCSG (deactivated SCell) (FR2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Mpss/sss\_with\_ncsg x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | Mpss/sss\_with\_ncsg x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Mpss/sss\_with\_ncsg x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.1-6: Time period for time index detection with NCSG (deactivated SCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | 3 x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | 3 x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | 3 x max(measCycleSCell, VIRP,DRX cycle) x CSSFintra |

#### 9.2.7.2 Measurement period

When *highSpeedMeasFlag-r16* is configured, the measurement period with NCSG is specified in Table 9.2.7.2-3.

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

Table 9.2.7.2-1: Measurement period for intra-frequency measurements with NCSG (FR1)

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

Table 9.2.7.2-2: Measurement period for intra-frequency measurements with NCSG (FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, Mmeas\_period with\_gaps x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps) x max(VIRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | Mmeas\_period with\_gaps x max(VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.2-3: Measurement period with NCSG When *highSpeedMeasFlag-r16* is configured (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, 5 x max(VIRP, SMTC period)) Note 1 x CSSFintra |
| DRX cycle≤ 160ms | max(200ms, ceil(M2Note 2 x 5) x max(VIRP, SMTC period,DRX cycle)) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | max(200ms, ceil(M2Note 2 x 4) x max(VIRP, DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Y Note 3 x max(VIRP, 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  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 3: Y=3 when SMTC <= 40ms, Y=5 when SMTC > 40ms  NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell. | |

**Table 9.2.7.2-4: Measurement period for intra-frequency measurements with NCSG (deactivated SCell) (FR1)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | 5 x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | 5 x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | 5 x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

**Table 9.2.7.2-5: Measurement period for intra-frequency measurements with NCSG (deactivated SCell) (FR2)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Mmeas\_period with\_gaps x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | Mmeas\_period with\_gaps x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Mmeas\_period with\_gaps x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

Note: Requirements for measurement on deactivated SCC in this clause do not apply if SMTC on the deactivated SCC is fully non-overlapped with NCSG, and the requirements for measurement on deactivated SCC specified in clause 9.2.5 apply.

#### 9.2.7.3 Scheduling availability during intra-frequency measurement with NCSG

Scheduling availability specified in 9.2.5.3 applies to scheduling availability during intra-frequency measurement with NCSG.

## 9.2A NR intra-frequency measurements with CCA

### 9.2A.1 Introduction

The requirements in clause 9.2.A apply for intra-frequency measurements on carrier frequency with CCA.

When the intra-frequency measurement is performed on a neighbour cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17*of the cell configured in *MeasObjectNR*. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 9.2A shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 9.2 shall apply.

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

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

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2A.5.3.

SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25 ms for frequency range FR2-2.

In the requirements of clause 9.2A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but *NSSB* candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period, where:

- For the cell detection procedure: *NSSB* is at least one candidate SSB position (NOTE: the one candidate SSB position for the cell detection shall not be impacted by the set of candidate SSB positions which are already being measured by the UE within the current measurement period of the on-going measurements), and

- For other procedures in clause 9.2A: *NSSB* are the first two successive candidate SSB positions when two or more candidate SSB positions are configured for this SSB index in one discovery burst transmission window, otherwise *NSSB* is one candidate SSB position;

otherwise the SMTC occasion is considered as available at the UE.

For the FR2-2 requirements of clause 9.2A, an SMTC occasion group consists of N consecutive SMTC occasions, where N is the UE Rx beam sweeping scaling factor. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.

### 9.2A.2 Requirements applicability

The requirements in clause 9.2A apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.27 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clause 10.1.29 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clause 10.1.31 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.8 for a corresponding Band.

### 9.2A.3 Number of cells and number of SSB

#### 9.2A.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2A.3.2 Requirements for FR2-2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC when UE is configured with NR-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report SSB based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with SS-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least 2 SSBs on serving cell for each of the other intra-frequency layer(s) in the same band.

### 9.2A.4 Measurement Reporting Requirements

9.2A.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1. 36 (RSRP for FR1), TBD (RSRP for FR2-2),10.1.29(RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2), respectively.

9.2A.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2) , respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2A.4.3.

9.2A.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2), respectively.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL CCA failures until the successful transmission of the report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T identify intra with index\_CCA or T identify intra without index\_CCA defined in clause 9.2A.5.1 or clause 9.2A.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period T identify\_intra\_without\_index\_CCA or T identify\_intra\_with\_index\_CCA as defined in clause 9.2A.5.1 or clause 9.2A.6.2. If a cell which has been detectable at least for the time period T identify intra without index\_CCA or T identify intra with index\_CCA defined in clause 9.2A.5.1 or clause 9.2A.6.2 becomes undetectable for a period≤ 8 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_CCA provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.2A.5 Intra-frequency measurements without measurement gaps

9.2A.5.1 Intra-frequency cell identification

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

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

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

Where:

TPSS/SSS\_sync\_intra\_CCA: it is the time period used in PSS/SSS detection given in table 9.2A.5.1-1, 9.2A.5.1-3 (deactivated Scell) .

TSSB\_time\_index\_intra\_CCA: it is the time period used to acquire the index of the SSB being measured given in table 9.2A.5.1-2 or 9.2A.5.1-4 (deactivated SCell).

T SSB\_measurement\_period\_intra\_CCA: equal to a measurement period of SSB based measurement given in table 9.2A.5.2-1, 9.2A.5.2-2 (deactivated Scell). 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.

- Mpss/sss\_sync\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_w/o\_gaps CCA = 36.

- Mmeas\_period\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mmeas\_period\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_w/o\_gaps CCA = 36.

- MSSB\_index\_intra\_CCA: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra CCA = 72 samples. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra CCA = 48 samples. For a UE supporting FR2 power class 3, MSSB\_index\_intra CCA = 48 samples.

N: is the UE Rx beam sweeping scaling factor. N= 12.

When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

When intra-frequency SMTC is partially overlapping with measurent gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP.

For FR2-2,

Klayer1\_measurement=TBD

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.5.1-1, Table 9.2A.5.1-2, Table 9.2A.5.1-3, Table 9.2A.5.1-4, Table 9.2A.5.1-5 and Table 9.2A.5.1-6 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.5.1-1, Table 9.2A.5.1-2, Table 9.2A.5.1-3, Table 9.2A.5.1-4, Table 9.2A.5.1-5 and Table 9.2A.5.1-6 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

Table 9.2A.5.1-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max( 600ms, ceil((5+LPSS/SSS) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x (5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+LPSS/SSS) x Kp) 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  NOTE 2: When DRX is not configured, LPSS/SSS is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. When DRX is configured, LPSS/SSS is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 3: LPSS/SSS,max =7 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,max =5 for 40ms<Max(DRX cycle,SMTC period)≤320ms, LPSS/SSS,max = 3 for DRX cycle>320ms.  NOTE 4: Upon exceeding LPSS/SSS,max, the UE is not required to meet the requirements for PSS/SSS detection. | |

Table 9.2A.5.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | max(120ms, ceil((3+Lind) x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x (3+Lind) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil((3+Lind) x Kp) 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  NOTE 2: When DRX is not configured, Lind is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When DRX is configured, Lind is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 3: Lind,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

Table 9.2A.5.1-3: Time period for PSS/SSS detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | (5 + LPSS/SSS,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5 + LPSS/SSS, deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (5 + LPSS/SSS, deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS, deact is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max. When DRX is configured, LPSS/SSS, deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max.When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: LPSS/SSS, deact,max, = 7 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max = 5 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, LPSS/SSS, deact,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding LPSS/SSS, deact,max,, the UE is not required to meet the requirements for PSS/SSS detection. | |

Table 9.2A.5.1-4: Time period for time index detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | (3+Lind,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (3+Lind,deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (3+Lind,deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,deact is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact < Lind,deact,max. When DRX is configured, Lind,deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact < Lind,deact,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lind,deact,max, = 5 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lind,deact,max = 3 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lind,deact,max = 2 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lind,deact,max over the period of time TSSB\_time\_index\_intra\_CCA,the UE has to restart the time index detection procedure. | |

Table 9.2A.5.1-5: Time period for PSS/SSS detection, (Frequency range FR2-2)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, ceil((Mpss/sss\_sync\_w/o\_gaps\_CCA x KFR + N x LPSS/SSS) x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x (Mpss/sss\_sync\_w/o\_gaps\_CCA x KFR + N x LPSS/SSS) x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((Mpss/sss\_sync\_w/o\_gaps\_CCA x KFR + N  x LPSS/SSS) 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  NOTE 2: When DRX is not configured, LPSS/SSS is the number of SMTC occasion groups not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. [A [DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: LPSS/SSS,max =[7] for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,max =[5] for 40ms<Max(DRX cycle,SMTC period)≤320ms, LPSS/SSS,max = [3] for DRX cycle>320ms.  NOTE 4: Upon exceeding LPSS/SSS,max, the UE is not required to meet the requirements for PSS/SSS detection.  NOTE 5: KFR is a scaling factor depending on the frequency range and SSB SCS. KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR= 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2A.5.1-6: Time period for PSS/SSS detection, deactivated SCell (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | Ceil((Mpss/sss\_sync\_w/o\_gaps x KFR + N x LPSS/SSS,deact) x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil((Mpss/sss\_sync\_w/o\_gaps x KFR + N x LPSS/SSS,deact) x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil((Mpss/sss\_sync\_w/o\_gaps x KFR + N x LPSS/SSS,deact) x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS, deact is the number of SMTC occasions groups not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS, deact is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max.When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle.  NOTE 2: LPSS/SSS, deact,max, = [7] for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max = [5] for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, LPSS/SSS, deact,max = [3] for DRX cycle>320ms.  NOTE 3: Upon exceeding LPSS/SSS, deact,max,, the UE is not required to meet the requirements for PSS/SSS detection.  NOTE 4: Void  NOTE 5: KFR is a scaling factor depending on the frequency range and SSB SCS. KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR= 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2A.5.1-7: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_CCA |
| No DRX | Max(200ms, ceil((MSSB\_index\_intra\_CCA + N ´ Lind) ´ Kp) ´ SMTC period) ´ CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, ceil(1.5 ´ ((MSSB\_index\_intra + N ´ Lind) ´ Kp) ´ Max(SMTC period, DRX cycle)) ´ CSSFintra |
| DRX cycle> 320ms | ceil((MSSB\_index\_intra + N ´ Lind) ´ Kp) ´ DRX cycle ´ 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  NOTE 2: When DRX is not configured, Lind is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When DRX is configured, Lind is the number of DRX cycles groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lind,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

Table 9.2A.5.1-8: Time period for time index detection, deactivated SCell (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_CCA |
| No DRX | Max(200ms, ceil((MSSB\_index\_intra\_CCA + N ´ Lind,deact) ´ Kp) ´ SMTC period) ´ CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, ceil(1.5 ´ ((MSSB\_index\_intra + N ´ Lind,deact) ´ Kp) ´ Max(SMTC period, DRX cycle)) ´ CSSFintra |
| DRX cycle> 320ms | ceil((MSSB\_index\_intra + N ´ Lind,deact) ´ Kp) ´ DRX cycle ´ 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  NOTE 2: When DRX is not configured, Lind,deact is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact ≤ Lind,deact,max. When DRX is configured, Lind,deact is the number of DRX cycles groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact ≤ Lind,deact,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lind,deact,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,deact,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,deact,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,deact,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

#### 9.2A.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2A.5.2-1, 9.2A.5.2-2 (deactivated SCell).

If SCG DRX is in use, intra-frequency measurement period requirements specified in Table 9.2A.5.2-1, Table 9.2A.5.2-2 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

When the time period of unsuccessful measurement attempts due to exceeding the maximum number of unavailable at the UE SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3, UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.

Table 9.2A.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(200ms, ceil((5+Lmeas) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+Lmeas) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+Lmeas) x Kp ) 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  NOTE 2: When DRX is not configured, Lmeas is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. When DRX is configured, Lmeas is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 3: Lmeas,max = 7 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,max = 5 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lmeas,max = 3 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lmeas,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

Table 9.2A.5.2-2: Measurement period for intra-frequency measurements without gaps, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | (5+Lmeas,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5+Lmeas, deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (5+Lmeas, deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,deact is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. When DRX is configured, Lmeas,deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lmeas, ,deact ,max, = 7 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lmeas, ,deact ,max = 5 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lmeas, ,deact ,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,deact,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

Table 9.2A.5.2-3: Measurement period for intra-frequency measurements without gaps (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(400ms, ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas) x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x (Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas) x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas) 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  NOTE 2: When DRX is not configured, Lmeas is the number of SMTC occasion groups not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. . [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lmeas,max = [7] for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,max = [5] for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lmeas,max = [3] for DRX cycle>320ms.  NOTE 4: Upon exceeding Lmeas,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

Table 9.2.5.2-4: Measurement period for intra-frequency measurements without gaps, deactivated Scell (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas,deact) x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas,deact) x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas,deact) x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,deact is the number of SMTC occasion groups not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas,deact is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lmeas, ,deact ,max, = [7] for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lmeas, ,deact ,max = [5] for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lmeas, ,deact ,max = [3] for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,deact,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

#### 9.2A.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2A.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, and on 1 data symbol before each consecutive SSB symbols configured to be measured and 1 data symbol after each consecutive SSB symbols configured to be measured within SMTC window duration if *deriveSSB-IndexFromCell* is enabled. If the high layer in TS 38.331[2] signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within SMTC window duration if *deriveSSB-IndexFromCell* is not enabled. If the high layer in TS 38.331 [2] signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB configured to be measured/RSSI symbols and 1 data symbol after each consecutive SSB configured to be measured/RSSI symbols within SMTC window duration if *deriveSSB-IndexFromCell* is enabled. If the high layer signaling of smtc2 is configured (in TS 38.331), the SMTC periodicity follows smtc2; Otherwise the SMTC periodicity follows smtc1.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within SMTC window duration if *deriveSSB-IndexFromCell* is not enabled. If the high layer in TS 38.331 signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

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

##### 9.2A.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- If *deriveSSB-IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If *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.

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

##### 9.2A.5.3.3 Scheduling availability of UE performing measurements in TDD bands on FR2-2

The requirements in clause 9.2.5.3.3 apply.

### 9.2A.6 Intra-frequency measurements with measurement gaps

#### 9.2A.6.1 Intra-frequency cell identification

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

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

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

Where:

TPSS/SSS\_sync\_intra\_CCA: it is the time period used in PSS/SSS detection given in table 9.2A.6.1-1.

TSSB\_time\_index\_intra\_CCA: it is the time period used to acquire the index of the SSB being measured given in table 9.2A.6.1-2.

T SSB\_measurement\_period\_intra\_CCA: equal to a measurement period of SSB based measurement given in table 9.2A.6.2-1 or 9.2A.6.1-3.

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.

Mpss/sss\_sync\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_w/o\_gaps CCA = 36.

Mmeas\_period\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mmeas\_period\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_w/o\_gaps CCA = 36.

- MSSB\_index\_intra\_CCA: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra CCA = 72 samples. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra CCA = 48 samples. For a UE supporting FR2 power class 3, MSSB\_index\_intra CCA = 48 samples.

N: is the UE Rx beam sweeping scaling factor. N= 12.

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.1-1, Table 9.2A.6.1-2 and Table 9.2A.6.1-3 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.1-1, Table 9.2A.6.1-2 and Table 9.2A.6.1-3 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

Table 9.2A.6.1-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, (5+LPSS/SSS,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x (5+LPSS/SSS,gaps)) x max(DRX cycle, MGRP, SMTC period)) x CSSFintra |
| DRX cycle>320ms | (5+LPSS/SSS,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS,gaps <LPSS/SSS,gaps,max. When DRX is configured, LPSS/SSS,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS,gaps <LPSS/SSS,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: LPSS/SSS,gaps,max, =7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,gaps,max =5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, LPSS/SSS,gaps,max =3 for DRX cycle>320ms.  NOTE 3: Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the requirements for PSS/SSS detection. | |

Table 9.2A.6.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | max(120ms, (3+Lind,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5x (3+Lind,gaps)) x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | (3+Lind,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lind,gaps,max, = 5 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = 3 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lind,gaps,max = 2 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lind,gaps,max over the TSSB\_time\_index\_intra\_CCA period of time, the UE has to restart the time index detection procedure. | |

Table 9.2A.6.1-3: Time period for PSS/SSS detection (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, (Mpss/sss\_sync\_with\_gaps\_CCA x KFR + N x Lind,gaps ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x (Mpss/sss\_sync\_with\_gaps\_CCA x KFR + N x Lind,gaps )) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | (Mpss/sss\_sync\_with\_gaps\_CCA x KFR + N x Lind,gaps ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,gaps is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lind,gaps is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max.[A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP.  NOTE 2: Lind,gaps,max, = [5] for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = [3] for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lind,gaps,max = [2] for DRX cycle>320ms.  NOTE 3: Upon exceeding Lind,gaps,max over the TSSB\_time\_index\_intra\_CCA period of time, the UE has to restart the time index detection procedure.  NOTE 4: KFR is a scaling factor depending on the frequency range and SSB SCS. KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2A.5.1-7: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_CCA |
| No DRX | Max(200ms, ceil((MSSB\_index\_intra + (Lind,gaps ´N)) ´ Kp) ´ Max(MGRP, SMTC period)) ´ CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, ceil(1.5 ´ (MSSB\_index\_intra + (Lind,gaps ´N)) ´ Kp) ´ Max(MGRP, SMTC period, DRX cycle)) ´ CSSFintra |
| DRX cycle> 320ms | ceil((MSSB\_index\_intra + (Lind,gaps ´N)) ´ Kp) ´ DRX cycle ´ 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  NOTE 2: When DRX is not configured, Lind is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,gaps ≤ Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,gaps ≤ Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lind,gaps,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,gaps,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

#### 9.2A.6.2 Intra-frequency Measurement Period

The measurement period for intra-frequency measurements with gaps is as shown in table 9.2A.6.2-1.

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.2-1 and 9.2A.6.2-2 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency measurement period requirements specified in Table 9.2A.6.2-1 and 9.2A.6.2-2 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

When the time period of unsuccessful measurement attempts due to exceeding the maximum number of unavailable at the UE SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3, UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.

Table 9.2A.6.2-1: Measurement period for intra-frequency measurements with gaps (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(200ms, (5+Lmeas,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+Lmeas,gaps)) x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | (5+Lmeas,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. When DRX is configured, Lmeas,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lmeas,gaps,max = 7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,gaps,max = 5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lmeas,gaps,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,gaps,max over the T SSB\_measurement\_period\_intra\_CCAperiod of time, the UE has to restart the measurement procedure. | |

Table 9.2A.6.2-2: Measurement period for intra-frequency measurements with gaps (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(400ms, (Mmeas\_period with\_gaps\_CCA + N x Lmeas,gaps ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x (Mmeas\_period with\_gaps\_CCA + N x Lmeas,gaps )) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | (Mmeas\_period with\_gaps\_CCA + N x Lmeas,gaps ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,gaps is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas,gaps is the number of DRX cycle groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP.  NOTE 2: Lmeas,gaps,max = 7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,gaps,max = 5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lmeas,gaps,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,gaps,max over the T SSB\_measurement\_period\_intra\_CCAperiod of time, the UE has to restart the measurement procedure. | |

### 9.2A.7 Intra-frequency RSSI and Channel occupancy measurements

#### 9.2A.7.1 Intra-frequency RSSI measurements

An RSSI measurement is defined as an intra-frequency measurement provided that the RSSI measurement bandwidth is fully contained within the current carrier bandwidth of the UE.

The UE physical layer shall be capable of performing the RSSI measurements, defined in TS 38.215 [4] on one or more serving carriers operating with CCA, TS 37.213 [33], if the carrier(s) are indicated by higher layers [2], and report the RSSI measurements to higher layers. The UE physical layer shall provide to higher layers a single RSSI sample for each OFDM symbol within each configured RSSI measurement duration [2] occurring with a configured RSSI measurement timing configuration periodicity [2], *rmtc-Periodicity*.

The UE can perform RSSI measurements without measurement gaps if RSSI measurement bandwidth is fully within the active DL BWP of the UE.

For performing intra-frequency RSSI measurement in FR2-2, UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to the DL RS associated with the TCI state provided in the RMTC configuration. UE does not expect to be configured with an explicit TCI-state in RMTC-Config with a reference serving cell in FR1 or FR2-1. If no TCI state is provided in the RMTC configuration, UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to one of the latest received PDSCH and the latest monitored CORESET in the active BWP of the current carrier in FR2-2.

For RSSI measurement in FR2-2 with SCS of 480 kHz or 960 kHz, the RSSI measurement results shall be derived based on symbols configured by RMTC except for the first symbol and the last symbol in RMTC, and there is no requirement when *measDurationSymbols* is configured as 1.

The measurement period for intra-frequency RSSI measurements without measurement gaps is as shown in Table 9.2A.7.1-1 and Table 9.2A.7.1-2, for FR1, and in Table 9.2A.7.4-1 and Table 9.2A.7.5-1 for FR2-2. The measurement period for intra-frequency RSSI measurements with measurement gaps is as shown in Table 9.2A.7.1-3, for FR1 and in Table 9.2A.7.1-6 for FR2-2.

Table 9.2A.7.1-1: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.1-2: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are not overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRXcycle length)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.1-3: Measurement period for intra-frequency RSSI measurements with measurement gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle length) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra 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. | |

Table 9.2A.7.1-4: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are overlapping (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.1-5: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are not overlapping (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRX cycle)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.1-6: Measurement period for intra-frequency RSSI measurements with measurement gaps (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra 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 UE requires measurement gaps to perform intra-frequency measurements, a single measurement gap pattern is used for all concurrent intra-frequency measurements, including intra-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The RSSI measurement performed and reported according to this clause shall meet the RSSI measurement accuracy requirement in Clause 10.1.34.1. The reported RSSI measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in Clause 10.1.34.3.

#### 9.2A.7.2 Intra-frequency Channel occupancy measurements

The UE shall be capable of estimating the channel occupancy on one or more serving carrier frequencies indicated by higher layers [2], based on RSSI samples provided by the physical layer.

The UE can perform channel occupancy measurements without measurement gaps if RSSI measurement bandwidth is fully within the active DL BWP of the UE.

The measurement period for intra-frequency channel occupancy measurements without measurement gap is as shown in Table 9.2A.7.2-1 and Table 9.2A.7.1-2 for FR1, and in Table 9.2A.7.2-4 and Table 9.2A.7.1-5 for FR2-2. The measurement period for intra-frequency RSSI measurements with measurement gaps is as shown in Table 9.2A.7.2-3 for FR1, and in Table 9.2A.7.2-6 for FR2-2 .

Table 9.2A.7.2-1: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, iis a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.2-2: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are not overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRXcycle length)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.2-3: Measurement period for intra-frequency Channel Occupancy measurements with measurement gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle length) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra 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. | |

Table 9.2A.7.2-4: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are overlapping (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T RSSI\_measurement\_period\_intra\_cca** |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.2-5: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are not overlapping (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T RSSI\_measurement\_period\_intra\_cca** |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRX cycle)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.2-6: Measurement period for intra-frequency Channel Occupancy measurements with measurement gaps (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T RSSI\_measurement\_period\_intra\_cca** |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra 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 UE requires measurement gaps to perform intra-frequency measurements, a single measurement gap pattern is used for all concurrent intra-frequency measurements, including intra-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The channel occupancy measurement performed and reported according to this clause shall meet the channel occupancy measurement accuracy requirements in Clause 10.1.35.1. The reported channel occupancy measurement values contained in measurement reports shall be based on the measurement reporting range specified in TS 38.331 [2].

#### 9.2A.7.3 Scheduling restriction during RSSI and Channel Occupancy measurements in FR1

When the UE performs intra-frequency RSSI/CO measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurements:

- The UE is not expected to transmit PUCCH/PUSCH/SRS on UL symbols which are overlapping in time with the RSSI measurement symbols configured by RMTC.

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

#### 9.2A.7.4 Scheduling restriction during RSSI measurements in FR2-2

When the UE performs intra-frequency RSSI measurements in unlicensed spectrum, the following restrictions apply due to RSSI measurements:

- The UE is not expected to transmit PUCCH/PUSCH/SRS on UL symbols which are overlapping in time with the RSSI measurement symbols configured by RMTC.

- The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on symbols which are overlapping in time with RSSI measurement symbols configured by RMTC if the RSSI measurement resources are not QCL-ed with typeD to the DL RS in the active TCI state of PDCCH/PDSCH.

- For 480 kHz and 960 kHz, The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on symbols which are overlapping in time with the first and last RSSI measurement symbols configured by RMTC.

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

## 9.2B NR intra-frequency measurements for RedCap

### 9.2B.1 Introduction

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the reference SSB of the serving cell and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same. The reference SSB is the SSB defined in BWP-specific *servingCellMO* under *BWP-DownlinkDedicated* of active DL BWP. If the field is absent, the reference SSB is the SSB defined in *servingCellMO* under *ServingCellConfig* [2].

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

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP [3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2B.5.3.

SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25ms for frequency range FR2.

### 9.2B.2 Requirements applicability

The requirements in clause 9.2B apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- For 2Rx RedCap:

- SS-RSRP related side conditions given in clauses 10.1.2 and 10.1.3 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7 and 10.1.8 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12 and 10.1.13 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

- For 1Rx RedCap:

- SS-RSRP related side conditions given in clauses [x.y.z] and [x.y.z] for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses [x.y.z] and [x.y.z] for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses [x.y.z] and [x.y.z] for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex [x.y.z] for a corresponding Band.

### 9.2B.3 Number of cells and number of SSB

#### 9.2B.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2B.3.2 Requirements for FR2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band.

### 9.2B.4 Measurement Reporting Requirements

#### 9.2B.4.1 Periodic Reporting

For 2Rx RedCap: The requirements in clause 9.2.4.1 shall apply.

For 1Rx RedCap: Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

#### 9.2B.4.2 Event-triggered Periodic Reporting

For 2Rx RedCap: The requirements in clause 9.2.4.2 shall apply.

For 1Rx RedCap: Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2B.4.3.

#### 9.2B.4.3 Event Triggered Reporting

For 2Rx RedCap: The requirements in clause 9.2.4.3 shall apply.

For 1Rx RedCap: Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The UE shall not send any event triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index\_RedCap or T identify intra without index\_RedCap defined in clause 9.2B.5.1 or clause 9.2B.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap as defined in clause 9.2B.5.1 or clause 9.2B.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index\_RedCap or Tidentify intra with index\_RedCap defined in clause 9.2B.5.1 or clause 9.2B.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_RedCap provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.2B.5 Intra-frequency measurements without measurement gaps for RedCap

#### 9.2B.5.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index\_RedCap if the UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_RedCap. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_RedCap. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

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

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

Where:

TPSS/SSS\_sync\_intra\_RedCap: it is the time period used in PSS/SSS detection given in tables 9.2B.5.1-1, 9.2B.5.1-2, 9.2B.5.1-3.

TSSB\_time\_index\_intra\_RedCap: it is the time period used to acquire the index of the SSB being measured given in tables 9.2B.5.1-4, 9.2B.5.1-5

T SSB\_measurement\_period\_intra\_RedCap: equal to a measurement period of SSB based measurement given in table 9.2B.5.2-1, table 9.2B.5.2-2, table 9.2B.5.2-3.

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

according to CSSFoutside\_gap\_RedCap,i in clause 9.1A.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap\_RedCap,i in clause 9.1A.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

if the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

For 2Rx RedCap:

Mpss/sss\_sync\_w/o\_gaps\_RedCap : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_w/o\_gaps\_RedCap =40. For a UE supporting power class 2, Mpss/sss\_sync\_w/o\_gaps\_RedCap =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_w/o\_gaps\_RedCap =24. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_w/o\_gaps\_RedCap =24, For a UE supporting FR2 power class 7, Mpss/sss\_sync\_w/o\_gaps\_RedCap = 24.

Mmeas\_period\_w/o\_gaps\_RedCap : For a UE supporting power class 1 or 5, Mmeas\_period\_w/o\_gaps\_RedCap =40. For a UE supporting FR2 power class 2, Mmeas\_period\_w/o\_gaps\_RedCap =24. For a UE supporting power class 3, Mmeas\_period\_w/o\_gaps\_RedCap =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps\_RedCap =24, For a UE supporting power class 7, Mmeas\_period\_w/o\_gaps\_RedCap = 24.

When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

When intra-frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap

For FR2,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

Table 9.2B.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil(5 x Kp) x SMTC period )Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-2: Time period for PSS/SSS detection, (Frequency range FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-3: Time period for PSS/SSS detection, (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil( 7 x Kp) x SMTC period )Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x 7 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(7 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-4: Time period for time index detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-5: Time period for time index detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(160ms, ceil( 6 x Kp )x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(160ms, ceil (1.5 x 6 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | Ceil(6 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2B.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2B.5.2-1, 9.2B.5.2-2, 9.2B.5.2-3.

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for TSSB\_measurement\_period\_intra\_RedCap.

For FR2, a longer measurement period is allowed, if aperiodic CSI-RS resource is measured for L1-RSRP measurement on any FR2 serving frequency in the same band, and the CSI-RS resource is outside measurement gap and overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols. If *SSB-ToMeasure* or *SS-RSSI-Measurement* is configured, the SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same band which can be merged and the RSSI symbols are indicated by *SS-RSSI-Measurement*.

Table 9.2B.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.2-2: Measurement period for intra-frequency measurements without gaps (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps\_RedCap xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.2-3: Measurement period for intra-frequency measurements without gaps (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max([200]ms, ceil( [5] x Kp) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max([200]ms, ceil(1.5x [5] x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil( [5] x Kp ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2B.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2B.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

##### 9.2B.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If the following conditions are met:

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

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

- The UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and/or the corresponding PDSCH, on SSB symbols to be measured.

##### 9.2B.5.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 intra-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration (The signaling *deriveSSB\_IndexFromCell* is always enabled for FR2). If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration (The signaling *deriveSSB\_IndexFromCellc* is always enabled for FR2). If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

If following conditions are met:

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

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

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

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

##### 9.2B.5.3.4 Scheduling availability of UE performing measurements in HD-FDD bands on FR1

When the UE performs intra-frequency measurements in a HD-FDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a HD-FDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

### 9.2B.6 Intra-frequency measurements with measurement gaps

#### 9.2B.6.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_RedCap. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_RedCap. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

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

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

Where:

TPSS/SSS\_sync\_intra\_RedCap: it is the time period used in PSS/SSS detection given in table 9.2B.6.1-1 or 9.2B.6.1-2 or 9.2B.6.1-3.

TSSB\_time\_index\_intra\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.2B.6.1-4 or 9.2B.6.1-5.

T SSB\_measurement\_period\_intra\_RedCap: equal to a measurement period of SSB based measurement given in table 9.2B.6.2-1 or 9.2B.6.2-2 or 9.2B.6.2-3.

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

For 2Rx RedCap:

Mpss/sss\_sync\_with\_gaps\_RedCap : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync with\_gaps\_RedCap =40. For a UE supporting FR2 power class 2, Mpss/sss\_sync with\_gaps\_RedCap =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync with\_gaps\_RedCap =24. For a UE supporting power class 4, Mpss/sss\_sync with\_gaps\_RedCap =24, For a UE supporting FR2 power class 7, Mpss/sss\_sync with\_gaps\_RedCap =24.

Mmeas\_period\_ with\_gaps\_RedCap: For a UE supporting power class 1 or 5, Mmeas\_period\_ with\_gaps\_RedCap =40. For a UE supporting power class 2, Mmeas\_period\_ with\_gaps\_RedCap =24. For a UE supporting power class 3, Mmeas\_period\_ with\_gaps\_RedCap =24. For a UE supporting power class 4, Mmeas\_period with\_gaps\_RedCap =24, For a UE supporting power class 7, Mmeas\_period\_ with\_gaps\_RedCap =24.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap.

Table 9.2B.6.1-1: Time period for PSS/SSS detection (FR1) for 2Rx RedCap UE

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

Table 9.2B.6.1-2: Time period for PSS/SSS detection (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps\_RedCap x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps\_RedCap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra\_RedCap\_RedCap |
| DRX cycle>320ms | Mpss/sss\_sync\_with\_gaps\_RedCap x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-3: Time period for PSS/SSS detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600 ms, 7 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600 ms, ceil(1.5 x 7) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | 7 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-4: Time period for time index detection (Frequency range FR1) for 2Rx RedCap UE

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

Table 9.2B.6.1-5: Time period for time index detection (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(160ms, 6 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(160ms, ceil(1.5 x 6) x max(MGRP, SMTC period,DRX cycle) x CSSFintra\_RedCap) |
| DRX cycle>320ms | [6] x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

#### 9.2B.6.2 Intra-frequency Measurement Period

The measurement period for FR1 intra-frequency measurements with gaps is as shown in table 9.2B.6.2-1 and in table 9.2B.6.2-3 for 1 Rx RedCap.

The measurement period for FR2 intra-frequency measurements with gaps is as shown in table 9.2B.6.2-2.

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

Table 9.2B.6.2-1: Measurement period for intra-frequency measurements with gaps (FR1) for 2Rx RedCap UE

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

Table 9.2B.6.2-2: Measurement period for intra-frequency measurements with gaps (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(400ms, Mmeas\_period with\_gaps\_RedCap x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps\_RedCap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra\_RedCap |
| DRX cycle>320ms | Mmeas\_period with\_gaps\_RedCap x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.2-3: Measurement period for intra-frequency measurements with gaps (FR1) for 1Rx RedCap UE

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

## 9.2C NR intra-frequency measurements for SAN

### 9.2C.1 Introduction

The requirements in clause 9.2C apply for intra-frequency measurements on an SAN carrier frequency. The requirements apply provided that the valid parameters of ephemeris information, epoch time of the ephemeris, common TA, validity timer information, downlink polarization information for target NR SAN cell are send to UE.

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

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

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement, or

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2C.5.3.

SSB based measurements are configured along with one or more measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements,

- when *SSB-MTC4List-r17* is not configured, up to two measurement window periodicities may be configured with *SSB-MTC* and *SSB-MTC2*

- when *SSB-MTC4List-r17* is configured, multiple measurement window offsets may be configured with *SSB-MTC* and *SSB-MTC4List-r17*, and the requriements in 9.2C apply provided that the total number of measurement window offsets does not exceed the UE capability [TBD]

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1.

### 9.2C.2 Requirements applicability

The requirements in clause 9.2C apply, provided:

- The cell being identified or measured is detectable.

- Valid information for the satellite serving the target cell has been provided- The number of configured SMTCs is no greater than [UE capability]

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1.2C for FR1, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7C for FR1, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12C for FR1, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

### 9.2C.3 Number of cells and number of SSB

#### 9.2C.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 8 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

- 4 SSBs with different SSB index and/or PCI from neighbour cells in GEO deployment.

- cells from 2 satellites including the satellite serving the PCell if UE does not support capability [TBD], cells from [4] satellites including the satellite serving the PCell, in LEO deployments

### 9.2C.4 Measurement Reporting Requirements

#### 9.2C.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses TBD (RSRP for FR1), TBD (RSRQ for FR1) and TBD (RS-SINR for FR1).

#### 9.2C.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses TBD (RSRP for FR1), TBD (RSRQ for FR1) and TBD (RS-SINR for FR1)..

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2C.4.3.

#### 9.2C.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses TBD (RSRP for FR1), TBD (RSRQ for FR1) and TBD (RS-SINR for FR1)..

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index or T identify intra without index defined in clause 9.2C.5.1 or clause 9.2C.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2C.5.1 or clause 9.2C.6.2. When L3 filtering is used, an additional delay can be expected.

### 9.2C.5 Intra frequency measurements without measurement gaps

#### 9.2C.5.1 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.5.1-1

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2C.5.1-2

TSSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2C.5.2-1

Kmulti\_SMTC is the scaling factor for measurement of multiple SMTCs or multiple satellites, and

if SMTCs do not overlap with each other,

- , if GEO satellites are measured on the carrier;

- , if LEO satellites are measured on the carrier;

if SMTCs partially overlap with each other,

- , if only GEO satellites are measured on the carrier;

- , if only LEO satellites are measured on the carrier;

where

- is the number of LEO satellites to be measured within i-th SMTC,

- is the number of LEO satellites that UE can measure in parallel within an SMTC,

- is the number of SMTCs that partially overlap with each other.

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 supports *parallelMeasurementGap-r17* and 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.

- Starting from the beginning of any SMTC occasion:

- 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.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil( 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC 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.5.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil( 3 x Kp x Klayer1\_measurement)x Kmulti\_SMTC x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(3 x Kp x Klayer1\_measurement) x Kmulti\_SMTC 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.5.1 and 9.2C.5.2 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.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2C.5.2-1.

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.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC 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.5.3 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.

##### 9.2C.5.3.1 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured(in TS 38.331 [2]), the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

##### 9.2C.5.3.2 Scheduling availability of UE performing measurements on a neighbor cell served by a different satellite in LEO

For UE which do not support *TBD* the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement on a neighbor cell served by a different satellite in LEO.

- 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.*

- If the following conditions are met:

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

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

- The UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and/or the corresponding PDSCH, on SSB symbols to be measured.

### 9.2C.6 Intra-frequency measurements with measurement gaps

#### 9.2C.6.1 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.6.2-1.

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2C.6.2-2.

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2C.6.3-1.

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.

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.

Kmulti\_SMTC is the scaling factor for measurement of multiple SMTCs or multiple satellites, and

if SMTCs within a measurement gap do not overlap with each other,

- , if GEO satellites are measured on the carrier;

- , if LEO satellites are measured on the carrier;

if SMTCs within a measurement gap partially overlap with each other,

- , if only GEO satellites are measured on the carrier;

- , if only LEO satellites are measured on the carrier;

where

- is the number of LEO satellites to be measured within i-th SMTC,

- is the number of LEO satellites that UE can measure in parallel within an SMTC,

- is the number of SMTCs that partially overlap with each other.

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.6.2-1: Time period for PSS/SSS detection (FR1)

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

Table 9.2C.6.2-2: Time period for time index detection (Frequency range FR1)

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

#### 9.2C.6.3 Intrafrequency Measurement Period

The measurement period for FR1 intrafrequency measurements with gaps is as shown in table 9.2C.6.3-1.

Table 9.2C.6.3-1: Measurement period for intra-frequency measurements with gaps (FR1)

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

## 9.3 NR inter-frequency measurements

### 9.3.1 Introduction

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2.

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

A measurement is defined as an inter-frequency SSB based measurements without measurement gaps (either legacy measurement gap or NCSG) in active BWP and its delay requirements are specified in clause 9.3.9, for UE capable of *interFrequencyMeas-NoGap* provided that

- the UE supports *interFrequencyMeas-Nogap-r16* [15], and

- the SSB is completely contained in the active BWP of the UE.

For UE supporting *nr-NeedForGapNCSG-reporting-r17* and indicating *NeedForGapNCSG-InfoNR* for inter-frequency measurement,

- An inter-frequency SSB measurement is defined as measurement without gap if

- the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE

The delay requirements are specified in clause 9.3.9.

- An inter-frequency SSB measurement is defined as measurement with NCSG if

- the UE indicates ‘ncsg’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE

When network configures NCSG, the delay requirements are specified in clause 9.3.10.

When network configures measurement gap, the delay requirements are specified in clauses 9.3.4 and 9.3.5.

- An inter-frequency SSB measurement is defined as measurement with gap if

- the UE indicates ‘gap’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE

When network configures measurement gap, the delay requirements are specified in clauses 9.3.4 and 9.3.5.

- For inter-frequency SSB based measurements with NCSG, UE may cause scheduling restriction as specified in clause 9.3.10.3.

For inter-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.3.5.3.

Note: Non-CA capable UE is not expected to indicate support of *interFrequencyMeas-Nogap-r16* [15].

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB and measure RSSI of RSRQ on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB and measure RSSI of RSRQ which ends later than the gap end – switching time. When the inter-frequency cells are in FR2 and the per-FR gap is configured to the UE in EN-DC, SA NR, NE-DC and NR-DC, or the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap is configured to the UE in SA NR and NR-DC, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

Longer measurement period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

### 9.3.2 Requirements applicability

The requirements in clause 9.3 apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1.4 and 10.1.5 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9 and 10.1.10 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14 and 10.1.15 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

#### 9.3.2.1 Void

#### 9.3.2.2 Void

### 9.3.3 Number of cells and number of SSB

#### 9.3.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

#### 9.3.3.2 Requirements for FR2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) or *deriveSSB-IndexFromCellInter-r17* is configured for the FR1 and FR2-1 target frequency layers and and UE supporting *deriveSSB-IndexFromCellInterNon-NCSG-r17*. 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 9.3.4-1, table 9.3.4-2, and table 9.3.4-5 when *highSpeedMeasInterFreq-r17* is configured and UE supports measurementEnhancementInterFreq-r17. When the SCG is deactivated, table 9.3.4-7 applies for an inter-frequency carrier configured by SCG and not configured by MCG and table 9.3.4-2 applies for an inter-frequency carrier configured by both SCG and MCG. Regardless of whether the SCG is activated or deactivated, table 9.3.4-2 applies for an inter-frequency carrier configured only by MCG.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3.4-3 and table 9.3.4-6 when *highSpeedMeasInterFreq* is configured and UE supports measurementEnhancementInterFreq-r17. When the SCG is deactivated, table 9.3.4-8 applies for an inter-frequency carrier configured by SCG and not configured by MCG and table 9.3.4-4 applies for an inter-frequency carrier configured by both SCG and MCG. Regardless of whether the SCG is activated or deactivated, table 9.3.4-4 applies for an inter-frequency carrier configured only by MCG.

TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.5-1, table 9.3.5-2 and table 9.3.5-3 when *highSpeedMeasInterFreq* is configured and UE supports measurementEnhancementInterFreq-r17. When the SCG is deactivated, table 9.3.5-4 applies for an inter-frequency carrier configured by SCG and not configured by MCG and table 9.3.5-2 applies for an inter-frequency carrier configured by both SCG and MCG. Regardless of whether the SCG is activated or deactivated, table 9.3.5-2 applies for an inter-frequency carrier configured only by MCG.

Mpss/sss\_sync\_inter: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_inter = 64 samples. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter = 96. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 60. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter = 60.

MSSB\_index\_inter: For a UE supporting FR2-1 power class 1 or 5, MSSB\_index\_inter = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-1 power class 3, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-1 power class 4, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-2 power class 2 or 3, MSSB\_index\_inter = 48 samples. For a UE supporting FR2 power class 1, MSSB\_index\_inter = 72 samples.

Mmeas\_period\_inter: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_inter =64. For a UE supporting FR2-1 power class 2, Mmeas\_period\_inter=40. For a UE supporting FR2-1 power class 3, Mmeas\_period\_inter =40. For a UE supporting FR2-1 power class 4, Mmeas\_period\_inter = 40. For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter = 96. For a UE supporting FR2-2 power class 2, Mmeas\_period\_inter = 60. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter = 60.

CSSFinter: 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.

Kgap is a 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. 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(s) and per-FR measurement gap(s) within the same FR, 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 dropped and non-dropped instances of the associated measurement gap 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 collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Kgap is only applicable for UE supporting *concurrentMeasGap-r17*. When concurrent measurement gaps are configured, requirements in this clause do not apply if Navailable =0.

Table 9.3.4-1: Time period for PSS/SSS detection (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | Max(600ms, Ceil(8 \* Kgap) × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 \* Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-2: Time period for PSS/SSS detection, (Frequency range FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | Max(600ms, Ceil(Kgap × Mpss/sss\_sync\_inter x KFR) × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(1.5 \* Kgap × Mpss/sss\_sync\_inter x KFR) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × Mpss/sss\_sync\_inter x KFR) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured.  NOTE 4: KFR is a scaling factor depending on the frequency range and the SSB SCS. For FR2-1, KFR = 1. For FR2-2: KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.3.4-3: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, Ceil(3 \* Kgap)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(3 \* Kgap)× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-4: Time period for time index detection (Frequency range FR2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(200ms, Ceil(Kgap × MSSB\_index\_inter)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(1.5 \* Kgap × MSSB\_index\_inter) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap ×MSSB\_index\_inter) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-5: Time period for PSS/SSS detection when highSpeedMeasInterFreq-r17 is configured (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | max(600ms, N1 × Max(MGRP, SMTC period)) × CSSFinter  N1 = 7 |
| DRX cycle ≤ 160ms | max(600ms, ceil(N2) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter  N2 = 7 x M2 |
| 160ms < DRX cycle ≤ 320ms | ceil(N3) x DRX cycle x CSSFinter  N3 = 7 x M2 |
| DRX cycle>320ms | N4 x DRX cycle x CSSFinter |
| 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  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 3: N4=6 if SMTC periodicity > 40 ms, otherwise N4=5 | |

Table 9.3.4-6: Time period for time index detection when highSpeedMeasInterFreq-r17 is configured (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TSSB\_time\_index\_inter |
| No DRX | Max(120ms, 3 × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × M2 NOTE3) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1. | |

Table 9.3.4-7: Time period for PSS/SSS detection when the inter-frequency carrier is configured only by SCG and the SCG is deactivated (FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | Max(600ms, Ceil(Kgap × Mpss/sss\_sync\_inter) × Max(MGRP, measCyclePSCell)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(1.5 \* Kgap × Mpss/sss\_sync\_inter) × Max(MGRP, measCyclePSCell, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × Mpss/sss\_sync\_inter) × Max(measCyclePSCell, DRX cycle) × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-8: Time period for time index detection when inter-frequency carrier is configured only by SCG and the SCG is deactivated (FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TSSB\_time\_index\_inter |
| No DRX | Max(200ms, Ceil(Kgap × MSSB\_index\_inter)× Max(MGRP, measCyclePSCell)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(1.5 \* Kgap × MSSB\_index\_inter) × Max(MGRP, measCyclePSCell, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap ×MSSB\_index\_inter) × Max(measCyclePSCell, DRX cycle) × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1.  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

#### 9.3.4.1 Void

#### 9.3.4.2 Void

### 9.3.5 Inter-frequency measurements

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 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3.5-1 and 9.3.5-2. When *highSpeedMeasInterFreq-r17* is configured, and UE supports *measurementEnhancementInterFreq-r17*, T SSB\_measurement\_period\_inter is specified in Table 9.3.5-3. When SCG is deactivated, T SSB\_measurement\_period\_inter is specified in Table 9.3.5-4 applies for inter-frequency carrier configured by SCG and not configured by MCG and table 9.3.5-2 applies for inter-frequency carrier configured by both SCG and MCG. Regardless of whether the SCG is activated or deactivated, table 9.3.5-2 applies for an inter-frequency carrier configured only by MCG.

Table 9.3.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, Ceil(8 \* Kgap) × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 \* Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.5-2: Measurement period for inter-frequency measurements with gaps (Frequency FR2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(400ms, Ceil(Kgap × Mmeas\_period\_inter)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400ms, Ceil(1.5 \* Kgap × Mmeas\_period\_inter) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × Mmeas\_period\_inter) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.5-3: Measurement period for inter-frequency measurements with gaps when highSpeedMeasInterFreq-r17 is configured (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, 7 × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 160ms | max(200ms, ceil(7 x M2 NOTE3) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| 160ms < DRX cycle ≤ 320ms | ceil(7 x M2 NOTE3) x DRX cycle x CSSFinter |
| DRX cycle>320ms | 4 x M2 NOTE3 x DRX cycle x CSSFinter |
| 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  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1 | |

Table 9.3.5-4: Measurement period for inter-frequency measurements with gaps when the inter-frequency carrier is configured only by SCG and the SCG is deactivated (FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T SSB\_measurement\_period\_inter |
| No DRX | Max(400ms, Ceil(Kgap × Mmeas\_period\_inter)× Max(MGRP, measCyclePSCell)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400ms, Ceil(1.5 \* Kgap × Mmeas\_period\_inter) × Max(MGRP, measCyclePSCell, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × Mmeas\_period\_inter) × Max(measCyclePSCell, DRX cycle) × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1.  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

#### 9.3.5.1 Void

#### 9.3.5.2 Void

#### 9.3.5.3 Void

### 9.3.6 Inter-frequency measurements reporting requirements

#### 9.3.6.1 Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

#### 9.3.6.2 Event-triggered Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.3.6.3.

#### 9.3.6.3 Event-triggered Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. Both Tidentify\_inter\_without\_index and Tidentify\_inter\_with\_index are defined in clause 9.3.4.When L3 filtering is used an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or in both FR1 and FR2 if the UE is not capable of per-FR gap.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2.5.1 or clause 9.2.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2.5.1 or clause 9.2.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

### 9.3.7 Void

### 9.3.8 Inter-frequency SFTD measurement requirements

#### 9.3.8.1 Introduction

This clause contains requirements for a UE supporting NR inter-frequency SFTD measurement and is applicable in RRC\_CONNECTED state. The UE shall, depending on network request, perform inter-frequency SFTD measurement and report SFTD result with or without SS-RSRP. The overall delay includes RRC procedure delay defined in clause 12 in TS 38.331 [2] and SFTD measurement reporting delay in clause 9.3.8.3.

UE which fulfils the requirements in clause 9.3.8 is not supposed to fulfil the requirements defined in clause 9.2.5.4.

#### 9.3.8.2 SFTD Measurement delay

The requirements on SFTD measurement delay defined in this clause are applicable under the side condition SCH Ês/Iot ≥ -3 dB for the inter-frequency neighbour cell. Depending on configuration, the SFTD measurement may be carried out with or without the support of configured measurement gaps. In the current release, indication on whether to carry out the SFTD measurement with or without measurement gaps is implicit and depending on whether measurement gaps are configured.

The UE shall be able to detect, identify and measure SFTD of up to 3 of the strongest applicable inter-frequency neighbour cells on the carrier frequency provided in the SFTD measurement configuration. Further depending on the SFTD measurement configuration, the UE shall additionally report SS-RSRP for the one or more strongest cells. The UE may or may not be configured with *cellsForWhichToReportSFTD*. The UE does not expect *cellsForWhichToReportSFTD* to change during an ongoing SFTD measurement.

When no measurement gaps are provided, the UE shall be capable of finding the inter-frequency neighbour cell regardless of its SSB position in the SMTC period, provided that the carrier frequency where SFTD measurement is configured and the serving carrier(s) form a supported CA or NR-DC band combination of the UE. The SFTD measurement shall be conducted with sustained connection to the PCell and activated SCell(s) in MCG. Depending on capability, the UE may be allowed to cause a certain amount of interruptions for reconfiguration of the radio receiver, as specified in clause 8.2.2.2.6.

When measurement gaps are provided, the UE shall be capable of finding the inter-frequency neighbour cell under the additional condition that the SSB at least occasionally falls within the measurement gap.

When no DRX is used, the UE shall be capable of determining SFTD within a physical layer measurement period of Tmeasure\_SFTD1 as follows:

- For SFTD measurements without measurement gaps, and without additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = 14 SMTC periods

- For carrier frequency in FR2: Tmeasure\_SFTD1 = 112 SMTC periods

- For SFTD measurements in measurement gaps, and without additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = CSSFinter × 8 × Max(MGRP, SMTC period)

- For carrier frequency in FR2: Tmeasure\_SFTD1 = CSSFinter × 64 × Max(MGRP, SMTC period))

- For SFTD measurements without measurement gaps, and with additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = 19 SMTC periods

- For carrier frequency in FR2: Tmeasure\_SFTD1 = 152 SMTC periods

- For SFTD measurements in measurement gaps, and with additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = CSSFinter × 13 × Max(MGRP, SMTC period)

- For carrier frequency in FR2: Tmeasure\_SFTD1 = CSSFinter × 104 × Max(MGRP, SMTC period)

where CSSFinter 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.

When DRX is used, the same Tmeasure\_SFTD1 as for non-DRX applies, but the reporting delay depends on the DRX cycle length in use.

In case PCell is changed due to handover, the UE shall terminate the inter-frequency SFTD measurement.

The measurement accuracy for the SFTD measurement shall fulfil the requirement in clause 10.1.21.3. The measurement accuracy for additionally reported SS-RSRP shall fulfil the requirement in clauses 10.1.4.1 and 10.1.5.1 for neighbour cell in FR1 and FR2, respectively.

#### 9.3.8.3 SFTD Measurement reporting delay

The SFTD measurement reporting delay is defined as the time between a command that will trigger an SFTD measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 × TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The SFTD measurement reporting delay shall be less than Tmeasure\_SFTD1 defined in clause 9.3.8.2 plus the RRC procedure delay defined in TS 38.331 [2].

### 9.3.9 Inter frequency measurements without measurement gaps

#### 9.3.9.1 Inter frequency Cell identification

UE satisfying the applicability conditions specified in 9.3.1 on the requirement in this clause 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) or *deriveSSB-IndexFromCellInter-r17* is configured for the FR1 and FR2-1 target frequency layers and and UE supporting *deriveSSB-IndexFromCellInterNon-NCSG-r17*. 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.

- For inter-frequency SSB based measurements without measurement gaps in active BWP, it is assumed that when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2, SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned

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 9.3.9.1-1 and table 9.3.9.1-2.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3.9.1-3.

T SSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.9.2-1, table 9.3.9.2-2 and table 9.3.9.2-3 when *highSpeedMeasInterFreq-r17* is configured and UE supports measurementEnhancementInterFreq-r17.

T SSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.9.2-1, table 9.3.9.2-2, and table 9.3.9.2-3 and table 9.3.9.2-3a when *highSpeedMeasInterFreq-r17* is configured and UE supports measurementEnhancementInterFreq-r17.

CSSFinter: 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 or NCSG, i.e. when interfrequency 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 interfrequency SMTC is fully overlapping with measurement gaps, or according to CSSFwithin\_ncsg,i in clause 9.1.5.x for measurement conducted within NCSG, i.e. when inter-frequency SMTC is fully overlapping with NCSG.

For inter-frequency SSB based measurements without measurement gaps in active BWP

Mpss/sss\_sync\_inter: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_inter = 40. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter = 24. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_inter = 24. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync = 24. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter = 36. For FR1, Mpss/sss\_sync\_inter = 5.

MSSB\_index\_inter: For a UE supporting FR2-2 power class 1, MSSB\_index\_inter = 72. For a UE supporting FR2-2 power class 2, MSSB\_index\_inter = 48. For a UE supporting FR2-2 power class 3, MSSB\_index\_inter = 48. For FR1, MSSB\_index\_inter = 3.

Mmeas\_period\_inter: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_inter = 40. For a vehicle mounted UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter=24. For a UE supporting FR2-1 power class 3, Mmeas\_period\_inter = 24. For a UE supporting FR2-1 power class 4, Mmeas\_period\_inter = 24. For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter = 36. For FR1, Mmeas\_period\_inter = 5.

If the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement,

Mpss/sss\_sync\_inter: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_inter = 64 samples. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter = 96. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 60. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter = 60. For FR1, Mpss/sss\_sync\_inter = 8.

MSSB\_index\_inter: For a UE supporting FR2-1 power class 1 or 5, MSSB\_index\_inter = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-1 power class 3, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-1 power class 4, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-2 power class 2 or 3, MSSB\_index\_inter = 48 samples. For a UE supporting FR2 power class 1, MSSB\_index\_inter = 72 samples. For FR1, MSSB\_index\_inter = 3.

Mmeas\_period\_inter: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_inter =64. For a UE supporting FR2-1 power class 2, Mmeas\_period\_inter=40. For a UE supporting FR2-1 power class 3, Mmeas\_period\_inter =40. For a UE supporting FR2-1 power class 4, Mmeas\_period\_inter = 40. For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter = 96. For a UE supporting FR2-2 power class 2, Mmeas\_period\_inter = 60. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter = 60. For FR1, Mmeas\_period\_inter = 8.When UE supports *concurrentMeasGap-r17* and is configured with concurrent measurement gaps,

Kp is a scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = 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 MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any SMTC occasion:

Ntotal is the total number of SMTC occasions within the window, including those overlapped with MG occasions within the window, and

Navailable is the number of SMTC occasions that are not overlapped with any non-dropped MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule provided that concurrent measurement gaps are configured.

Kp = 1 when Navailable = 0.

Otherwise, when UE is not configured with or UE does not support concurrent measurement gaps:

When interfrequency SMTC is fully non overlapping with measurement gaps or NCSG, or interfrequency SMTC is fully overlapping with MGs or NCSG, Kp =1.

When interfrequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. When inter-frequency SMTC is partially overlapping with NCSG, Kp = 1/(1- (SMTC period /VIRP)), where SMTC period < VIRP.

For FR2,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by inter-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by inter-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by *SSB-ToMeasure* 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.

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.*

Table 9.3.9.1-1: Time period for PSS/SSS detection, (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max( 600ms, ceil(Mpss/sss\_sync\_inter x Kp) x SMTC period )Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max( 600ms, ceil(M2x Mpss/sss\_sync\_inter x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter x Kp) x DRX cycle x CSSFinter |
| 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  NOTE 2: Void  NOTE 3: When *highSpeedMeasInterFreq-r17* is not configured, M2 = 1.5; When *highSpeedMeasInterFreq-r17* is configured, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Table 9.3.9.1-2: Time period for PSS/SSS detection, (FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement) x DRX cycle x CSSFinter |
| 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  NOTE 2: Void | |

Table 9.3.9.1-3: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter |
| No DRX | max(120ms, ceil(MSSB\_index\_inter x Kp )x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(120ms, ceil (M2 x MSSB\_index\_inter x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | Ceil(MSSB\_index\_inter x Kp) x DRX cycle x CSSFinter |
| 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  NOTE 2: Void  NOTE 3: When *highSpeedMeasInterFreq-r17* is not configured, M2 = 1.5; When *highSpeedMeasInterFreq-r17* is configured, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Table 9.3.9.1-4: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(200ms, Ceil(MSSB\_index\_inter x Kp)× SMTC period) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(1.5 × MSSB\_index\_inter x Kp) × Max(SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(MSSB\_index\_inter x Kp) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Kp is applicable for UE supporting [concurrent gaps] | |

#### 9.3.9.2 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 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3.9.2-1 and 9.3.9.2-2, if UE supports inter-frequency measurement without measurement gaps. When highSpeedMeasInterFreq-r17 is configured and UE supports [measurementEnhancementInterFreq-r17], T SSB\_measurement\_period\_inter is specified in table 9.3.9.2-3.

Table 9.3.9.2-1: Measurement period for inter-frequency measurements without gaps ((FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, ceil(Mmeas\_period\_inter x Kp) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x Mmeas\_period\_inter x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil( Mmeas\_period\_inter x Kp ) x DRX cycle x CSSFinter |
| 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 9.3.9.2-2: Measurement period for inter-frequency measurements without gaps (FR2)

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_inter** |
| No DRX | max(400ms, ceil(Mmeas\_period\_inter x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_inter x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(Mmeas\_period\_inter xKp x Klayer1\_measurement) x DRX cycle x CSSFinter |
| 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 9.3.9.2-3: Measurement period for inter-frequency measurements without gaps in the active BWP when highSpeedMeasInterFreq-r17 is configured (FR1)

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_inter** |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 160ms | max(200ms, ceil(5 x M2 Note 2 x Kp) x max(SMTC period, DRX cycle)) x CSSFinter |
| 160ms < DRX cycle≤ 320ms | ceil(4 x M2 Note 2 x Kp) x max(SMTC period,DRX cycle) x CSSFinter |
| DRX cycle>320ms | ceil( Y Note 3 x Kp ) x DRX cycle x CSSFinter |
| 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  NOTE 2: M2 = 1.5 if SMTC period > 40 ms, otherwise M2 = 1  NOTE 3: Y=3 when SMTC period <= 40ms, Y=5 when SMTC period > 40ms | |

Table 9.3.9.2-3a: Measurement period for inter-frequency measurements without gaps when highSpeedMeasInterFreq-r17 is configured (FR1), UE supporting ‘nogap-noncsg’

|  |  |
| --- | --- |
| Condition NOTE1,2 | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, 7 × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 160ms | max(200ms, ceil(7 x M2 NOTE3) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| 160ms < DRX cycle ≤ 320ms | ceil(7 x M2 NOTE3) x DRX cycle x CSSFinter |
| DRX cycle>320ms | 4 x M2 NOTE3 x DRX cycle x CSSFinter |
| 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  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1 | |

#### 9.3.9.3 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.

The scheduling availability requirements when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2 in clause 9.3.9.3.1~9.3.9.3.3 are valid under the following conditions:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned

##### 9.3.9.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

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

##### 9.3.9.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-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 the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO i, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if deriveSSB-IndexFromCellInter-r17 is enabled for MO i and UE supporting *deriveSSB-IndexFromCellInterNon-NCSG-r17*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9, or

- serving cell symbols fully or partially overlap with SMTC window for MO i and on 1 serving cell symbol before and after the SMTC window, if deriveSSB-IndexFromCellInter-r17 is not enabled for MO i, or UE supporting *deriveSSB-IndexFromCellInterNon-NCSG-r17*,

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

##### 9.3.9.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 inter-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration*.*

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

If following conditions are met:

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

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

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

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

##### 9.3.9.3.4 Scheduling availability of UE performing measurements on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to measurements performed on FR2 serving cell frequency layer.

There are no scheduling restrictions on FR2 serving cell(s) due to measurements performed on FR1 serving cell frequency layer.

### 9.3.10 Inter-frequency measurement with NCSG

#### 9.3.10.1 Inter-frequency cell identification

For the UE supporting NCSG, if NCSG is provided, 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) or *deriveSSB-IndexFromCellInter-r17* is 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 9.3.10.1-1 and table 9.3.10.1-2.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3.10.1-3 and table 9.3.10.1-4.

TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.10.2-1 and table 9.3.10.2-2.

Mpss/sss\_sync\_inter: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_inter = 64 samples. For a UE supporting FR2 power class 2, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_inter = 40 samples.

MSSB\_index\_inter: For a UE supporting FR2 power class 1 or 5, MSSB\_index\_inter = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter = 24 samples. For a UE supporting FR2 power class 3, MSSB\_index\_inter = 24 samples. For a UE supporting FR2 power class 4, MSSB\_index\_inter = 24 samples.

Mmeas\_period\_inter: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter =64 samples. For a UE supporting FR2 power class 2, Mmeas\_period\_inter=40 samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter =40 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter = 40 samples.

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_ncsg,i in clause 9.1.5.x for measurement conducted within NCSG.

**Table 9.3.10.1-1: Time period for PSS/SSS detection with NCSG (FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, 8 × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.10.1-2: Time period for PSS/SSS detection with NCSG (FR2)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, Mpss/sss\_sync\_inter × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, (1.5 × Mpss/sss\_sync\_inter) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Mpss/sss\_sync\_inter × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.10.1-3: Time period for time index detection with NCSG (FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, 3 × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.**10**.1-4: Time period for time index detection with NCSG (FR2)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(200ms, MSSB\_index\_inter × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, (1.5 × MSSB\_index\_inter) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | MSSB\_index\_inter × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

#### 9.3.10.2 Measurement period

When NCSG are provided for inter frequency measurements, 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 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3.10.2-1 and 9.3.10.2-2:

**Table 9.3.10.2-1: Measurement period for inter-frequency measurements with NCSG (FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, 8 × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.10.2-2: Measurement period for inter-frequency measurements with NCSG (FR2)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(400ms, Mmeas\_period\_inter × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400ms, (1.5 × Mmeas\_period\_inter) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Mmeas\_period\_inter × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

#### 9.3.10.3 Scheduling availability during inter-frequency measurement with NCSG

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.

The requirements in clause 9.3.10.3.3 based on *deriveSSB-IndexFromCell-inter* apply provided that UE supports ncsg-*SymbolLevelScheduleRestrictionInter-r17*. If UE does not support *ncsg-SymbolLevelScheduleRestrictionInter-r17*, the requirements in clause 9.3.10.3.3 apply assuming *deriveSSB-IndexFromCell-inter* is not enabled.

##### 9.3.10.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs inter-frequency measurements with NCSG in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement when (1) *simultaneousRxTxInterBandCA* is not supported for the target measurement band and the serving cell’s band, or (2) target measurement and the serving cell are on the same band

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*,

When the UE performs inter-frequency measurements with NCSG in a TDD band, the following restrictions apply due to SS-RSRQ measurement when *simultaneousRxTxInterBandCA* is not supported for the target measurement band and the serving cell band

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*.

If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When TDD intra-band carrier aggregation or TDD inter-band carrier aggregation without *simultaneousRxTxInterBandCA* support is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells on the symbols that fully or partially overlap with the aforementioned restricted symbols.

When the UE performs inter-frequency measurements with NCSG in a TDD band and *simultaneousRxTxInterBandCA* is supported for the target measurement band and a serving cell’ band, no scheduling restriction applies to the serving cell.

##### 9.3.10.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement when the target inter-frequency layer to be measured is on the same band with UE’s serving cell(s).

Editor’s note: FFS when target frequency layer to be measured is on the different band but with overlapped spectrum with UE’s serving cell(s)

- The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,*

If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

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

##### 9.3.10.3.3 Scheduling availability of UE performing measurements on FR2

When (1) UE does not support IBM between target measurement band and serving cell’s band(s) nor *simultaneousRxTxInterBandCA*, or (2) target measurement and a serving cell are on the same band, the following scheduling restriction applies to the serving cell due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell with NCSG:

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB‑IndexFromCellInter‑r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.8.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*,

and due to SS-RSRQ measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.8.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*.

When UE does not support IBM between target measurement band and serving cell’s band(s) but supports *simultaneousRxTxInterBandCA*, the following scheduling restriction applies to the serving cell due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB‑IndexFromCellInter‑r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*,

and due to SS-RSRQ measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.8.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*.

When UE supports IBM between target measurement band and serving cell’s band(s) but not *simultaneousRxTxInterBandCA*, the following scheduling restriction applies to the serving cell due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB‑IndexFromCellInter‑r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9..

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,*

and due to SS-RSRQ measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*. △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i*.

If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

When UE supports IBM between target measurement band and serving cell’s band(s) and *simultaneousRxTxInterBandCA*, no scheduling restriction applies to the serving cell.

If following conditions are met:

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

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

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

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

##### 9.3.10.3.4 Scheduling availability of UE performing measurements on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to measurements performed on FR2 serving cell frequency layer.

There are no scheduling restrictions on FR2 serving cell(s) due to measurements performed on FR1 serving cell frequency layer.

## 9.3A NR inter-frequency measurements in carrier frequencies with CCA

### 9.3A.1 Introduction

The requirements in clause 9.3A apply for inter-frequency measurements on a carrier frequency with CCA. A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2A.The UE shall be able to identify new inter-frequency cells in carrier frequencies with CCA and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified inter-frequency cells if carrier frequency information is provided by PCell or PSCell, even if no explicit neighbour list with physical layer cell identities is provided.

When the inter-frequency measurement is performed on a neighbour cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17*of the cell configured in *MeasObjectNR*. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 9.3A shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 9.3 shall apply.

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time.

In the requirements of clause 9.3A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but N candidate SSB positions for the same SS/PBCH block index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation or measurement period, where:

- For the cell detection procedure: N is at least one candidate SSB position (NOTE: the one candidate SSB position for the cell detection shall not be impacted by the set of candidate SSB positions which are already being measured by the UE within the current measurement period of the on-going measurements), and

- For other procedures in clause 9.3A: N are the first two successive candidate SSB positions when two or more candidate SSB positions are configured for this SSB index in one discovery burst transmission window, otherwise N is one candidate SSB position;

otherwise the SMTC occasion is considered as available at the UE.

For the FR2-2 requirements of clause 9.3A, an SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.

### 9.3A.2 Requirements applicability

The requirements in clause 9.3A apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency CCA cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.28,

- SS-RSRQ related side conditions given in clause 10.1.30 and TBD for FR1 and FR2-2, respectively,

- SS-SINR related side conditions given in clause 10.1.32 and TBD for FR1 and FR2-2, respectively,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.9.

### 9.3A.3 Number of cells and number of SSB

#### 9.3A.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB indexes and/or PCI on the inter-frequency layer.

#### 9.3A.3.2 Requirements for FR2-2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3A.4 Inter-frequency cell identification

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\_cca\_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, in carrier frequencies with CCA, within Tidentify\_inter\_cca\_with\_index. The UE shall be able to identify a new detectable inter-frequency SS block, in carrier frequencies with CCA, of an already detected cell within Tidentify\_inter\_cca\_without\_index.

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

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

Where:

TPSS/SSS\_sync\_inter\_cca: it is the time period used in PSS/SSS detection given in table 9.3A.4-1 and table 9.3A.4-3.

TSSB\_time\_index\_inter\_cca: it is the time period used to acquire the index of the SSB being measured given in table 9.3A.4-2 and Table 9.3A.4-4.

T SSB\_measurement\_period\_inter\_cca: equal to a measurement period of SSB based measurement given in table 9.3A.5-1.

CSSFinter : 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.

Mpss/sss\_sync\_inter\_CCA: For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter CCA = 96. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter CCA = 60. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter CCA = 60.

MSSB\_index\_inter\_CCA: For a UE supporting FR2-2 power class 2 or 3, MSSB\_index\_inter CCA = 48 samples. For a UE supporting FR2 power class 1, MSSB\_index\_inter CCA = 72 samples

Mmeas\_period\_inter\_CCA: For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter CCA = 96. For a UE supporting FR2-2 power class 2, Mmeas\_period\_inter CCA = 60. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter CCA = 60

Table 9.3A.4-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | TPSS/SSS\_sync\_inter\_cca |
| No DRX | max(600ms, (8+LPSS/SSS,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(600ms, ceil((8+LPSS/SSS,gaps)x1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+LPSS/SSS,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_inter\_cca, for PSS/SSS detection, where LPSS/SSS,gaps ≤ LPSS/SSS,gaps,max. When DRX is configured, LPSS/SSS,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_inter\_cca, for PSS/SSS detection, where LPSS/SSS,gaps ≤ LPSS/SSS,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: LPSS/SSS,gaps,max = 12 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms LPSS/SSS,gaps,max = 8 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and LPSS/SSS,gaps,max = 5 for DRX cycle > 320 ms. | |

Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the corresponding PSS/SSS detection requirement. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

Table 9.3A.4-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | TSSB\_time\_index\_inter\_cca |
| No DRX | max(120ms, (3+ Lind,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(120ms, ceil((3+ Lind,gaps) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (3 + Lind,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_inter\_cca for time index identification, where Lind,gaps ≤ Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_inter\_cca for time index identification, where Lind,gaps ≤ Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: Lind,gaps,max = 5 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lind,gaps,max = 3 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lind,gaps,max = 2 for DRX cycle > 320 ms. | |

The UE shall restart the time index detection upon exceeding Lind,gaps,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

Table 9.3A.4-3: Time period for PSS/SSS detection, (Frequency range FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, ceil(Mpss/sss\_sync\_inter\_CCA+ [NRxBeam] x LPSS/SSS,gaps))× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, ceil(1.5 × Mpss/sss\_sync\_inter\_CCA+ [NRxBeam] x LPSS/SSS,gaps)) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Mpss/sss\_sync\_inter\_CCA+ [NRxBeam] x LPSS/SSS,gaps)× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 3: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasion groups not available at the UE during TPSS/SSS\_sync\_inter\_CCA for PSS/SSS detection, where LPSS/SSS,gaps < LPSS/SSS,gaps,max. A SMTC occasion group consists of NRxBeam consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_inter\_CCA for PSS/SSS detection, where LPSS/SSS,gaps < LPSS/SSS,gaps,max . [A DRX occasion group consists of NRxBeam consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 4: LPSS/SSS,gaps = 12 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms LPSS/SSS,gaps = 8 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and LPSS/SSS,gaps = 5 for DRX cycle > 320 ms | |

Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the corresponding PSS/SSS detection requirement. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

Table 9.3A.4-4: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | TSSB\_time\_index\_inter\_cca |
| No DRX | max(120ms, ceil(MSSB\_index\_inter\_CCA + [NRxBeam] x Lind,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(120ms, ceil(MSSB\_index\_inter\_CCA + [NRxBeam] x Lind,gaps) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | ceil(MSSB\_index\_inter\_CCA + [NRxBeam] x Lind,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during **TSSB\_time\_index\_inter\_cca**, for for time index identification, where Lind,gaps ≤ Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during **TSSB\_time\_index\_inter\_cca**, for for time index identification, where Lind,gaps ≤ Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 3: Lind,gaps,max = [5] for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lind,gaps,max = [3] for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lind,gaps,max = [2] for DRX cycle > 320 ms. | |

The UE shall restart the time index detection upon exceeding Lind,gaps,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

### 9.3A.5 Inter-frequency measurements

When measurement gaps are provided for inter-frequency measurements in carrier frequencies with CCA, 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 10.1.28, 10.1.30, 10.1.32, respectively, as shown in table 9.3A.5-1:

Table 9.3A.5-1: Measurement period for inter-frequency measurements with gaps

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T SSB\_measurement\_period\_inter\_cca |
| No DRX | max(200ms, (8+ Lmeas) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(200ms, ceil((8+ Lmeas) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+ Lmeas) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, Lmeas is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_NR\_cca, for inter-frequency measurements with gaps, where Lmeas ≤ Lmeas,max. When DRX is configured, Lmeas is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_NR\_cca, for inter-frequency measurements with gaps, where Lmeas ≤ Lmeas,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: Lmeas,max = 12 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lmeas,max = 8 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lmeas,max = 5 for DRX cycle > 320 ms. | |

The UE shall restart the measurement upon exceeding Lmeas,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

The UE shall stop the measurement attempts on the SSB of a cell and perform the detection procedure again, like for any other SSB, when the following conditions are met:

- Lmeas > Lmeas,max, and

- The time period of unsuccessful measurement attempts exceeds the maximum time required for the cell to remain known as defined in clause 9.3A.6.3.

Table 9.3A.5-2: Measurement period for inter-frequency measurements with gaps(FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T SSB\_measurement\_period\_inter\_cca |
| No DRX | max(200ms, ceil(Mmeas\_period\_inter\_CCA + [NRxBeam] x Lmeas,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(200ms, ceil(Mmeas\_period\_inter\_CCA + [NRxBeam] x Lmeas,gaps) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | ceil(Mmeas\_period\_inter\_CCA + [NRxBeam] x Lmeas,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, Lmeas,gaps is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_inter\_cca, for inter-frequency measurements with gaps, where Lmeas,gaps ≤ Lmeas,gaps,max. When DRX is configured, Lmeas,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_NR\_cca, for inter-frequency measurements with gaps, where Lmeas,gaps ≤ Lmeas,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: Lmeas,gaps,max = [12] for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lmeas,gaps,max = [8] for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lmeas,gaps,max = [5] for DRX cycle > 320 ms. | |

The UE shall restart the measurement upon exceeding Lmeas,gap,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

### 9.3A.6 NR Inter-frequency measurements reporting requirements

#### 9.3A.6.1 Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.28, 10.1.30, and 10.1.32, respectively.

#### 9.3A.6.2 Event-triggered Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.28, 10.1.30, and 10.1.32, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.3A.6.3.

#### 9.3A.6.3 Event-triggered Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.28, 10.1.30, and 10.1.32, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report, and all delays due to UL CCA failures until the successful transmission of the report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_cca\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter-frequency cell within Tidentify\_inter\_cca \_with\_index. Both Tidentify\_inter\_cca \_without\_index and Tidentify\_inter\_cca \_with\_index are defined in clause 9.3A.4.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_inter\_cca \_without\_index or Tidentify\_inter\_cca \_with\_index defined in clause 9.3A.4. If a cell which has been detectable at least for the time period Tidentify\_inter\_cca \_without\_index or Tidentify\_inter\_cca \_with\_index defined in clause 9.3A.4 becomes undetectable for a period ≤ 8 seconds and then the cell becomes detectable again with the same spatial reception parameter and then triggers the measurement report as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_inter\_cca defined in clause 9.3A.5 provided the timing to that cell has not changed more than ± 3200/ Tc while measurement gap has not been available and the L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used an additional delay can be expected.

### 9.3A.8 Inter-frequency RSSI measurements

An RSSI measurement is defined as an inter-frequency measurement provided that the RSSI measurement bandwidth is not contained within the current carrier bandwidth of the UE.

The UE physical layer shall be capable of performing the RSSI measurements, defined in TS 38.215 [4] on one or more inter-frequency carriers operating with CCA, TS 37.213 [33], if the carrier(s) are indicated by higher layers [2], and report the RSSI measurements to higher layers. The UE physical layer shall provide to higher layers a single RSSI sample for each OFDM symbol within each configured RSSI measurement duration [2] occurring with a configured RSSI measurement timing configuration periodicity [2], *rmtc-Periodicity*. The requirements apply if *rmtc-SubframeOffset* [2] is configured.

For performing inter-frequency RSSI measurement in FR2-2,

- If a UE has serving cell in FR2-2,

- If the TCI state is provided in RMTC configuration of FR2-2, the UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to the DL RS associated with the TCI state provided in the RMTC configuration. The UE does not expect to be configured with an explicit TCI-state in RMTC-Config with a reference serving cell in FR1 or FR2-1. If no TCI state is provided in the RMTC configuration, the UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to one of the latest received PDSCH and the latest monitored CORESET in the active BWP of a serving carrier in FR2-2.

- If a UE has no serving cell in FR2-2,

- The UE does not expect that a TCI state is provided in RMTC configuration. It is up to UE implementation how to determine the spatial domain filter for the inter-frequency RSSI measurement in FR2-2, and no requirements are defined.

For RSSI measurement in FR2-2 with SCS of 480 kHz or 960 kHz, the RSSI measurement results shall be derived based on symbols configured by RMTC except for the first symbol and the last symbol in RMTC, and there is no requirements when *measDurationSymbols* is configured as 1.

Table 9.3A.8-1: Measurement period for inter-frequency RSSI measurements with gaps

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T RSSI\_measurement\_period\_inter\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFinter) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFinter) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFinter 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 UE requires measurement gaps to perform inter-frequency measurements, a single measurement gap pattern is used for all concurrent inter-frequency measurements, including inter-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The RSSI measurement performed and reported according to this clause shall meet the RSSI measurement accuracy requirement in Clause 10.1.34.2. The reported RSSI measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in Clause 10.1.34.3.

### 9.3A.9 Inter-frequency channel occupancy measurements

The UE shall be capable of estimating the channel occupancy on one or more carrier frequencies indicated by higher layers [2], based on RSSI samples provided by the physical layer. The requirements apply if *rmtc-SubframeOffset* [2] is configured.

Table 9.3A.9-1: Measurement period for inter-frequency Channel Occupancy measurements with gaps

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T CO\_measurement\_period\_inter\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFinter) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFinter) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFinter 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 UE requires measurement gaps to perform inter-frequency measurements, a single measurement gap pattern is used for all concurrent inter-frequency measurements, including inter-frequency channel occupancy measurements. The RSSI measurement duration used for channel occupancy measurement and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The channel occupancy measurement performed and reported according to this clause shall meet the channel occupancy measurement accuracy requirements in Clause 10.1.35.2. The reported channel occupancy measurement values contained in measurement reports shall be based on the measurement reporting range specified in TS 38.331 [2].

## 9.3B NR inter-frequency measurements for RedCap

### 9.3B.1 Introduction

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2B.

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

A measurement is defined as an inter-frequency SSB based measurements without measurement gaps for UE capable of *interFrequencyMeas-NoGap* provided

- the UE supports *interFrequencyMeas-Nogap-r16* [15], and

- the SSB is completely contained in the active BWP of the UE.

For inter-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause [9.3B.7.3].

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which ends later than the gap end – switching time. When the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap or per-FR gap is configured to the UE in SA NR, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

Longer measurement period would be expected during the period Tidentify\_CGI\_RedCap when the UE is requested to decode an NR/E-UTRA CGI.

### 9.3B.2 Requirements applicability

The requirements in clause 9.3B apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- For 2 Rx RedCap UE:

- SS-RSRP related side conditions given in clauses 10.1.4 and 10.1.5 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9 and 10.1.10 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14 and 10.1.15 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

- For 1 Rx RedCap UE:

- SS-RSRP related side conditions given in clauses [x.y.z] for FR1, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses [x.y.z] for FR1, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses [x.y.z] for FR1, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex [x.y.z] for a corresponding Band.

### 9.3B.3 Number of cells and number of SSB

#### 9.3B.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

#### 9.3B.3.2 Requirements for FR2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3B.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_RedCap. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index\_RedCap.

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

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

Where:

TPSS/SSS\_sync\_inter\_RedCap: it is the time period used in PSS/SSS detection given in table 9.3B.4-1, table 9.3B.4-2, table 9.3B.4-3.

TSSB\_time\_index\_inter\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.3B.4-4, table 9.3B.4-5, table 9.3B.4-6.

TSSB\_measurement\_period\_inter\_RedCap: equal to a measurement period of SSB based measurement given in table 9.3B.5-1, table 9.3B.5-2, table 9.3B.5-3.

*Editor’s note: which power class to be used for RedCap depends on the RF session outcome.*

For 2 Rx RedCap UE:

Mpss/sss\_sync\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_inter\_RedCap = 64 samples. For a UE supporting FR2 power class 2, Mpss/sss\_sync\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_inter\_RedCap = 40 samples, For a UE supporting FR2 power class 7, Mpss/sss\_sync\_inter\_RedCap = 40 samples.

MSSB\_index\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, MSSB\_index\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 3, MSSB\_index\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 4, MSSB\_index\_inter\_RedCap = 24 samples, For a UE supporting FR2 power class 7 MSSB\_index\_inter\_RedCap =24 samples.

Mmeas\_period\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter\_RedCap =64 samples. For a UE supporting FR2 power class 2, Mmeas\_period\_inter\_RedCap =40 samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter\_RedCap =40 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter\_RedCap = 40 samples, For a UE supporting FR2 power class 7 Mmeas\_period\_inter\_RedCap =40 samples.

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

Table 9.3B.4-1: Time period for PSS/SSS detection (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, 8 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-2: Time period for PSS/SSS detection, (Frequency range FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, Mpss/sss\_sync\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, (1.5 × Mpss/sss\_sync\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | Mpss/sss\_sync\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-3: Time period for PSS/SSS detection (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, 10 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(10 \*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 10 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-4: Time period for time index detection (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(120ms, 3 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-5: Time period for time index detection (Frequency range FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(200ms, MSSB\_index\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(200ms, (1.5 × MSSB\_index\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | MSSB\_index\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-6: Time period for time index detection (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(160ms, [6] × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(160ms, Ceil([6] × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | [6] × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

### 9.3B.5 Inter-frequency measurements

When measurement gaps are provided for inter frequency measurements, the 2Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3B.5-1 and 9.3B.5-2.

**Table 9.3B.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1) for 2Rx RedCap UE**

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(200ms, 8 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.5-2: Measurement period for inter-frequency measurements with gaps (Frequency FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(400ms, Mmeas\_period\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(400ms, (1.5 × Mmeas\_period\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | Mmeas\_period\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

When measurement gaps are provided for inter frequency measurements, the 1Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively, as shown in table 9.3B.5-3.

Table 9.3B.5-3: Measurement period for inter-frequency measurements with gaps (Frequency FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(400ms, 8× Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(400ms, ceil(1.5 × 8) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

### 9.3B.6 Inter-frequency measurements reporting requirements

#### 9.3B.6.1 Periodic Reporting

For 2 Rx RedCap UE: The requirements in clause 9.3.6.1 shall apply.

For 1 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively.

#### 9.3B.6.2 Event-triggered Periodic Reporting

For 2 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

For 1 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause [9.3B.6.3].

#### 9.3B.6.3 Event-triggered Reporting

For 2 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

For 1 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index\_ RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_ RedCap. Both Tidentify\_inter\_without\_index\_ RedCap and Tidentify\_inter\_with\_index\_ RedCap are defined in clause 9.3B.4.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index\_ RedCap or Tidentify\_intra\_with\_index\_ RedCap as defined in clause 9.2B.5.1 or clause 9.2B.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index\_ RedCap or Tidentify intra with index\_ RedCap defined in clause 9.2B.5.1 or clause 9.2B.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_ RedCap provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.3B.7 Inter frequency measurements without measurement gaps

#### 9.3B.7.1 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\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_RedCap. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index\_RedCap. It is assumed that when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2, the following conditions are met:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

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

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

Where:

TPSS/SSS\_sync\_inter\_RedCap: it is the time period used in PSS/SSS detection given in table 9.3B.7.1-1, table 9.3B.7.1-2 and table 9.3B.7.1-3.

TSSB\_time\_index\_inter\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.3B.7.1-4 and table 9.3B.7.1-5.

T SSB\_measurement\_period\_inter\_RedCap: equal to a measurement period of SSB based measurement given in table 9.3B.7.2-1, table 9.3B.7.2-2 and table 9.3B.7.2-3.

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

Mpss/sss\_sync\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 2, Mpss/sss\_sync\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_RedCap = 24 samples. For a UE supporting FR2 power class 7, Mpss/sss\_sync\_inter\_RedCap = 24 samples.

MSSB\_index\_inter\_RedCap: For a UE supporting power class 1 or 5, MSSB\_index\_inter\_RedCap = 40 samples. For a vehicle mounted UE supporting power class 2, Mpss/sss\_sync\_inter\_RedCap = 24 samples. For a UE supporting power class 3, MSSB\_index\_inter\_RedCap = 24 samples. For a UE supporting power class 4, Mmeas\_period\_inter\_RedCap = 24 samples. For a UE supporting power class 7, MSSB\_index\_inter\_RedCap = 24 samples.

Mmeas\_period\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter\_RedCap =40 samples. For a vehicle mounted UE supporting FR2 power class 2, Mpss/sss\_sync\_inter\_RedCap =24 samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter\_RedCap =24 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 7, Mmeas\_period\_inter\_RedCap =24 samples.

When interfrequency SMTC is fully non overlapping with measurement gaps or interfrequency SMTC is fully overlapping with MGs, Kp=1.

When interfrequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP.

For FR2,

Klayer1\_measurement =1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by inter-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by inter-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by *SSB-ToMeasure* and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

Table 9.3B.7.1-1: Time period for PSS/SSS detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter\_RedCap |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-2: Time period for PSS/SSS detection (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter\_RedCap |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_inter\_RedCap x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_inter\_RedCap x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter\_RedCap x Kp x Klayer1\_measurement) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-3: Time period for PSS/SSS detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter\_RedCap |
| No DRX | max( 600ms, ceil( 7 x Kp) x SMTC period )Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 7 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(7 x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-4: Time period for time index detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter\_RedCap |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-5: Time period for time index detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter\_RedCap |
| No DRX | max(160ms, ceil( [6] x Kp )x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(160ms, ceil (1.5 x [6] x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | Ceil([6] x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.3B.7.2 Measurement period

The 2Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3B.7.2-1 and 9.3B.7.2-2, if UE supports inter-frequency measurement without measurement gaps:

Table 9.3B.7.2-1: Measurement period for inter-frequency measurements without gaps ((FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.2-2: Measurement period for inter-frequency measurements without gaps (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter\_RedCap |
| No DRX | max(400ms, ceil(Mmeas\_period\_inter\_RedCap x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_inter\_RedCap x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(Mmeas\_period\_inter\_RedCap xKp x Klayer1\_measurement) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

The 1Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z] and [x.y.z], respectively, as shown in table 9.3B.7.2-3, if UE supports inter-frequency measurement without measurement gaps:

Table 9.3B.7.2-3: Measurement period for inter-frequency measurements without gaps ((FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max([200]ms, ceil( [5] x Kp) x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max([200]ms, ceil(1.5x [5] x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil( [5] x Kp ) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.3B.7.3 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.

The scheduling availability requirements when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2 and HD-FDD bands on FR1 in clause 9.3B.7.3.1~9.3B.7.3.4 are valid under the following conditions:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

##### 9.3B.7.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

##### 9.3B.7.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-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.

##### 9.3B.7.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 inter-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration*.*

If following conditions are met:

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

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

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

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

##### 9.3B.7.3.4 Scheduling availability of UE performing measurements in HD-FDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a HD-FDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a HD-FDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

## 9.3C NR inter-frequency measurements for SAN

### 9.3C.1 Introduction

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2. The requirements apply provided the valid parameters of ephemeris information, epoch time of the ephemeris, common TA, validity timer information, downlink polarization information for target NR SAN cell are send to UE.

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

A measurement is defined as an inter-frequency SSB based measurements without measurement gaps for UE capable of *interFrequencyMeas-NoGap* provided

- the UE supports *interFrequencyMeas-Nogap-r16* [15], and

- the SSB is completely contained in the active BWP of the UE.

For inter-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.3C.5.3.

SSB based measurements are configured along with up to 2 measurement timing configurations (SMTC) in parallel per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, the measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which ends later than the gap end – switching time, and the switching time is 0.5ms.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

### 9.3C.2 Requirements applicability

The requirements in clause 9.3C apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1C.4 and 10.1C.5 for FR1, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1C.9 and 10.1C.10 for FR1, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1C.14 and 10.1C.15 for FR1, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

### 9.3C.3 Number of cells and number of SSB

#### 9.3C.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- [4] identified cells, and

- [7] SSBs with different SSB index and/or PCI on the inter-frequency layer.

- 4 SSBs with different SSB index and/or PCI from neighbour cells in GEO deployment.

### 9.3C.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index 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.4-1.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3C.4-2.

TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3C.5-1.

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. 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.

K\_satellite: it is a statellite specific scaling factor.

* If SMTCs within a measurement gap do not overlap with each other, and if LEO satellite(s) is/are required to be measured within SMTC
  + K\_satellite = 1, if GSO satellites are measured on the carrier
  + , if LEO satellites are measured on the carrier.
* If SMTCs within a measurement gap partially overlap with each other, and if LEO and/or GEO satellite(s) is/are required to be measured within overlapped SMTCs
  + , if only GEO satellites are measured on the carrier
  + , if only LEO satellites are measured on the carrier.

Table 9.3C.4-1: Time period for PSS/SSS detection (Frequency range FR1)

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, Ceil(8 x Kgap) × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter × K\_satellite |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5 x Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter × K\_satellite |
| DRX cycle > 320ms | Ceil(8 x Kgap) × DRX cycle × CSSFinter × K\_satellite |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 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.4-2: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, Ceil(3 x Kgap) × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter × K\_satellite |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5 x Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter × K\_satellite |
| DRX cycle > 320ms | Ceil(3 x Kgap) × DRX cycle × CSSFinter × K\_satellite |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 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.5 Inter-frequency measurements

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.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1)

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, Ceil(8 x Kgap) × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter × K\_satellite |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5 x Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter × K\_satellite |
| DRX cycle > 320ms | Ceil(8 x Kgap) × DRX cycle × CSSFinter × K\_satellite |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 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.6 Inter-frequency measurements reporting requirements

#### 9.3C.6.1 Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1C.4.1, 10.1C.5.1, 10.1C.9.1, 10.1C.10.1, 10.1C.14.1 and 10.1C.15.1, respectively.

#### 9.3C.6.2 Event-triggered Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1C.4.1, 10.1C.5.1, 10.1C.9.1, 10.1C.10.1, 10.1C.14.1 and 10.1C.15.1, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.3C.6.3.

#### 9.3C.6.3 Event-triggered Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1C.4.1, 10.1C.5.1, 10.1C.9.1, 10.1C.10.1, 10.1C.14.1 and 10.1C.15.1, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. Both Tidentify\_inter\_without\_index and Tidentify\_inter\_with\_index are defined in clause 9.3C.4.When L3 filtering is used an additional delay can be expected. I

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2C.5.1 or clause 9.2C.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2C.5.1 or clause 9.2C.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.3C.7 Inter frequency measurements without measurement gaps

#### 9.3C.7.1 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. It is assumed that when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1, the following conditions are met:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

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.7.1-1.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3C.7.1-2.

T SSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3C.7.2-1.

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 supports *parallelMeasurementGap-r17* and 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.

- Starting from the beginning of any SMTC occasion:

- 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.

Ksatellite: it is a satellite specific scaling factor.

* If SMTCs do not overlap with each other, and if LEO and/or GEO satellite(s) is/are required to be measured within SMTC
  + Ksatellite = 1, if GSO satellite(s) is/are measured on the carrier
  + , if LEO satellite(s) is/are measured on the carrier.
* If SMTCs partially overlap with each other, and if LEO and/or GEO satellite(s) is/are required to be measured within overlapped SMTCs
  + , if only GEO satellite(s) is/are measured on the carrier
  + , if only LEO satellite(s) is/are measured on the carrier.

Table 9.3C.7.1-1: Time period for PSS/SSS detection, (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFinter × Ksatellite |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter × Ksatellite |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter × Ksatellite |
| 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.7.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFinter × Ksatellite |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter × Ksatellite |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFinter × Ksatellite |
| 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.7.2 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.7-1: Measurement period for inter-frequency measurements without gaps ((FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter × K\_satellite |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter × K\_satellite |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter × K\_satellite |
| 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.7.3 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.

The scheduling availability requirements when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 in clause 9.3C.7.3.1~9.3C.7.3.3 are valid under the following conditions:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

##### 9.3C.7.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

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

##### 9.3C.7.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-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 should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

## 9.4 Inter-RAT measurements

### 9.4.1 Introduction

The requirements in this clause are specified for NR−E-UTRAN FDD and NR−E-UTRAN TDD measurements and are applicable without an explicit E-UTRAN neighbour cell list containing physical layer cell identities, for a UE:

- in RRC\_CONNECTED state, and

- configured

- with SA or NR-DC operation mode or configured in NE-DC operation mode by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR, RSTD, or E-CID RSRP and RSRQ) on E-UTRA non-serving frequency carrier, or

- with SA operation mode on NR carrier frequencies with CCA by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR) on E-UTRA non-serving frequency carrier, and

- configured with an appropriate measurement gap pattern according to Table 9.1.2-3.

The requirements in this clause for concurrent measurement gaps are only applied for UE in NR SA operation mode.

For UE supporting *eutra-NeedForGapNCSG-reporting-r17* and indicating *NeedForGapNCSG-InfoEUTRA* for inter-RAT measurement,

- An inter-RAT measurement is defined as measurement without gap if

- the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoEUTRA* for the inter-RAT measurement

- An inter-RAT measurement is defined as measurement with NCSG if

- the UE indicates ‘ncsg’ via *NeedForGapNCSG-InfoEUTRA* for the inter-RAT measurement

When network configures measurement gap or NCSG, the delay requirements are specified in clause 9.4.2 and 9.4.3.

- An inter-RAT SSB measurement is defined as measurement with gap if

- the UE indicates ‘gap’ via *NeedForGapNCSG-InfoEUTRA* for the inter-RAT measurement

When network configures measurement gap, the delay requirements are specified in clauses 9.4.2 and 9.4.3.

- For inter-RAT measurements with NCSG, UE may cause scheduling restriction as specified in clause 9.4.3.5.

When the UE is in NE-DC operation mode and an NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR, or E-CID RSRP and RSRQ) configured by NR PCell is on a E-UTRA serving frequency carrier, then the corresponding E-UTRA intra-frequency measurements requirements specified in clause 8.19 of TS 36.133 [15] shall apply.

When *highSpeedMeasFlag-r16* is configured but UE does not support either *measurementEnhancement-r16 or* *interRAT-MeasurementEnhancement-r16*, the UE is not required to meet the requirements specified in Table 9.4.2.3-2 and Table 9.4.3.3-2.

*Editor’s note: the exact signalling names in the above brackets and in Table 9.4.2.3-2 and Table 9.4.3.3-2 are subject to RAN2 definitions and the brackets shall be replaced by the correct signalling names according to RAN2 specification.*

Parameter TInter1 used in inter-RAT requirements in clause 9.4 is specified in Table 9.4.1-1 when measurement gap is used, and in Table 9.4.1-2 when NCSG is used.

Table 9.4.1-1: Minimum available time for inter-RAT measurements measurements when measurement gap is configured

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1, ms) |
| 0 | 6 | 40 | 60 |
| 1 | 6 | 80 | 30 |
| 2 | 3 | 40 | 24Note 1 |
| 3 | 3 | 80 | 12Note 1 |
| 4 | 6 | 20 | 120 Note 1 |
| 6 | 4 | 20 | 72 Note 1,3,6 |
| 7 | 4 | 40 | 36 Note 1,4,6 |
| 8 | 4 | 80 | 18Note 1,5,6 |
| 10 | 3 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1 for gap pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1 = 60 for gap pattern IDs 2, 4, 6, 7, 10, and Tinter1 = 30 for gap pattern IDs 3 and 8 shall be used.  NOTE 2: Measurement gaps pattern configurations applicability is as specified in Table 9.1.2-1.  NOTE 3: When this gap pattern is used, the Tinter for E-UTRA inter-frequency measurements is 48 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 4: When this gap pattern is used, the Tinter for E-UTRA inter-frequency measurements is 24 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 5: When this gap pattern is used, the Tinter for E-UTRA inter-frequency measurements is 12 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 6: This gap pattern is applicable for E-UTRA inter-frequency measurements only if gap based NR measurements are also configured.  NOTE 7: If multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layers. | | | |

Table 9.4.1-2: Minimum available time for inter-RAT measurements when NCSG is configured

|  |  |  |  |
| --- | --- | --- | --- |
| NCSG Pattern Id | Measurement Length (ML, ms) | Visible Interruption Repetition Period  (VIRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1, ms) |
| 0 | 5 | 40 | 60 |
| 1 | 5 | 80 | 30 |
| 2 | 2 | 40 | 24Note 1 |
| 3 | 2 | 80 | 12Note 1 |
| 4 | 5 | 20 | 120 Note 1 |
| 6 | 3 | 20 | 72 Note 1,3 |
| 7 | 3 | 40 | 36 Note 1,3 |
| 8 | 3 | 80 | 18Note 1,3 |
| 10 | 2 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1 for NCSG pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1 = 60 for NCSG pattern IDs 2, 4, 6, 7, 10, and Tinter1 = 30 for NCSG pattern IDs 3 and 8 shall be used.  NOTE 2: NCSG pattern configurations applicability is as specified in Table 9.1.2C-1.  NOTE 3: This NCSG pattern is applicable for E-UTRA inter-frequency measurements only if NCSG based NR measurements are also configured. | | | |

A UE configured with gap/NCSG pattern ID 2, 3 or 10 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends not later than 500 μs before the end of the measurement gap in case of FDD and not later than 750 μs before the end of measurement gap in case of TDD.

A UE configured with gap/NCSG pattern ID 6, 7 or 8 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends no later than 1500 μs before the end of the measurement gap in case of FDD and no later than 1750 μs before the end of measurement gap in case of TDD.

### 9.4.2 NR − E-UTRAN FDD measurements

#### 9.4.2.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN FDD cell is considered to be detectable when:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4.2.2 Requirements when no DRX is used

When the UE requires measurement gaps or NCSG to identify and measure inter-RAT cells and an appropriate measurement gap pattern or NCSG is scheduled, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are scheduled, or an appropriate pre-MG is scheduled and activated, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable FDD cell within TIdentify, E-UTRAN FDD according to the following expression:

,

where:

TBasicIdentify = 480 ms,

TInter1 is defined in clause 9.4.1,

CSSFinterRAT = CSSFwithin\_gap,i when measurement gaps are configured, or CSSFwithin\_ncsg,i when NCSGs are configured, is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1.5.2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

Ntotal is the total number of associated gap occasions within the window, including those dropped and non-dropped ocassions of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure, E-UTRAN FDD defined in Table 9.4.2.2-1.

**Table 9.4.2.2-1:** M**easurement period and measurement bandwidth**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 480 x [CSSFinterRAT x Ceil(Kgap\_EUTRA)] | 6 |
| 1 (Note 1) | 240 x [CSSFinterRAT x Ceil(Kgap\_EUTRA)] | 50 |
| NOTE 1: This configuration is optional.  NOTE 2: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | | |

When measurement gaps are scheduled for E-UTRAN FDD inter-RAT measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting RSRP, RSRQ, and RS-SINR measurements to higher layers with measurement period TMeasure, E-UTRAN FDDgiven by table 9.4.2.2-1.

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.2.3 Requirements when DRX is used

When DRX is in use and an appropriate measurement gap pattern or NCSG is configured, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are configured, or an appropriate pre-MG is scheduled and activated, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify, E-UTRAN FDD specified in Table 9.4.2.3-1. When *highSpeedMeasFlag-r16* is configured and UE supports the enhanced inter-RAT E-UTRAN measurement requirements, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify, E-UTRAN FDD specified in Table 9.4.2.3-2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

Ntotal is the total number of associated gap occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Table 9.4.2.3-1: Requirement to identify a newly detectable E-UTRAN FDD cell

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN FDD (s) (DRX cycles)** | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.256 | 5.12\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (30\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32 | 6.4\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (24\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.2.2.  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 4: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

Table 9.4.2.3-2: Requirement to identify a newly detectable E-UTRAN FDD cell when *highSpeedMeasFlag-r16* is configured

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify, E-UTRAN FDD (s) (DRX cycles) | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.16<DRx cycle<=0.32 | Note 1(15\*CSSFinterRAT x Ceil((Kgap\_EUTRA)) |  |
| 0.32<DRx cycle <= 0.64 | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |  |
| DRx cycle = 1.024 | Note 1(10\*CSSFinterRAT x Ceil( Kgap\_EUTRA)) | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| DRx cycle = 1.28 | Note 1(8\*CSSFinterRAT x Ceil( Kgap\_EUTRA)) | Note 1(8\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil( Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.2.2.  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[interRAT-MeasurementEnhancement-r16].*  NOTE 4: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 5: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure, E-UTRAN FDD specified in Table 9.4.2.3-2.

**Table 9.4.2.3-2: Requirement to measure E-UTRAN FDD cells**

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (5\* CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.2.2.  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | |

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.2.4 Measurement reporting requirements

##### 9.4.2.4.1 Periodic Reporting

The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

##### 9.4.2.4.2 Event-Triggered Periodic Reporting

The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.2.4.3.

##### 9.4.2.4.3 Event-Triggered Reporting

The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify, E-UTRAN FDD defined in clauses 9.4.2.2 and 9.4.2.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify, E-UTRAN FDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure, E-UTRAN FDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap or NCSG has not been available and the L3 filter has not been used.

### 9.4.3 NR − E-UTRAN TDD measurements

#### 9.4.3.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN TDD cell is considered to be detectable when:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4.3.2 Requirements when no DRX is used

When the UE requires measurement gaps or NCSG to identify and measure inter-RAT cells and an appropriate measurement gap pattern or NCSG is scheduled, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are scheduled, or an appropriate pre-MG is scheduled and activated or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable TDD cell within TIdentify, E-UTRAN TDD according to the following expression:

- When configuration 0 or configuration 1 in Table 9.4.3.2-1 is applied,

,

- When configuration 2 or configuration 3 in Table 9.4.3.2-1 is applied,

,

where:

TBasicIdentify = 480 ms,

TInter1 is defined in clause 9.4.1,

CSSFinterRAT = CSSFwithin\_gap,i when measurement gaps are configured, or CSSFwithin\_ncsg,i when NCSGs are configured, is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1.5.2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

- For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

- Ntotal is the total number of associated gap occasions within the window, including those dropped and non-dropped ocassions of the associated measurement gap within the window, and

- Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

- Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure, E-UTRAN TDD defined in Table 9.4.3.2-1.

Table 9.4.3.2-1: TMeasure, E-UTRAN TDD for different configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 480 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 240 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| 2 | 6 | 1 | 3 |  |  | 720 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 480 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| NOTE 1: This configuration is optional.  NOTE 2: Void  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | | | | | | |

When measurement gaps are scheduled for E-UTRAN TDD inter-RAT measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting RSRP, RSRQ, and RS-SINR measurements to higher layers with measurement period Tmeasure, E-UTRAN TDD given by table 9.4.3.2-1.

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.3.3 Requirements when DRX is used

When DRX is in use and an appropriate measurement gap pattern or NCSG is configured, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are configured, or an appropriate pre-MG is scheduled and activated, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify, E-UTRAN TDD specified in Table 9.4.3.3-1. When *highSpeedMeasFlag-r16* is configured and UE supports the enhanced inter-RAT E-UTRAN measurement requirements, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify, E-UTRAN TDD specified in Table 9.4.3.3-2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

Ntotal is the total number of associated gap occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Table 9.4.3.3-1: Requirement to identify a newly detectable E-UTRAN TDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.256 | 5.12\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (30\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32 | 6.4\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (24\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2.  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 4: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

Table 9.4.3.3-2: Requirement to identify a newly detectable E-UTRAN TDD cell when *highSpeedMeasFlag-r16* is configured

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.16<DRx cycle<=0.32 | Note 1(15\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |  |
| 0.32<DRx cycle <= 0.64 | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |  |
| DRx cycle = 1.024 | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| DRx cycle = 1.28 | Note 1(8\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note 1(8\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2.  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[interRAT-MeasurementEnhancement-r16].*  NOTE 4: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 5: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure, E-UTRAN TDD specified in Table 9.4.3.3-3.

Table 9.4.3.3-3: Requirement to measure E-UTRAN TDD cells

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause 9.4.3.2 apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause 9.4.3.2 apply,  Otherwise: Note1 (5\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.128<DRX-cycle≤10.24 | Note1 (5\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2.  NOTE 3: See Table 9.4.3.2-1.  NOTE 4: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | |

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.3.4 Measurement reporting requirements

##### 9.4.3.4.1 Periodic Reporting

The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

##### 9.4.3.4.2 Event-Triggered Periodic Reporting

The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.3.4.3.

##### 9.4.3.4.3 Event-Triggered Reporting

The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify, E-UTRAN TDD defined in clauses 9.4.3.2 and 9.4.3.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify, E-UTRAN TDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure, E-UTRAN TDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap or NCSG has not been available and the L3 filter has not been used.

#### 9.4.3.5 Scheduling Availability During NR − E-UTRAN TDD measurements with NCSG

When UE supports *simultaneousRxTxInterBandENDC* for a band combination, no scheduling restriction is applicable to NR − E-UTRAN TDD measurements with NCSG in this band combination; otherwise UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within NCSG ML.

### 9.4.4 Inter-RAT RSTD measurements

#### 9.4.4.1 NR − E-UTRAN FDD RSTD measurements

##### 9.4.4.1.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSTD measurements requested via LPP [22, 27].

When the UE is in NE-DC operation mode and an NR−E-UTRAN FDD RSTD measurement configured by NR PCell is on a E-UTRA serving frequency carrier, then the corresponding E-UTRA intra-frequency measurements requirements as follows shall apply.

- Measurements configured on E-UTRA PSCC shall meet E-UTRAN OTDOA intra-frequency measurements requirements in clause 8.1.2.5. The applicable measurement accuracy requirements are in clause 9.1.10.

- Measurements configured on E-UTRA SCC shall meet all applicable requirements in clause 8.4, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC. The applicable measurement accuracy requirements are in clause 9.1.12, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC.

The requirements in clause 9.4.4.1 apply when:

- the UE is provided with the LTE timing information via LPP [27], including both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset*, or

- the UE is not provided with *nr-LTE-SFN-Offset* or *nr-LTE-fineTiming-Offset*, or

- the UE is provided with *nr-LTE-SFN-Offset* but not with *nr-LTE-fineTiming-Offset*.

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE may be using autonomous gaps to acquire SFN of the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.1.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to acquire the SFN before the  starts.

When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps to perform cell detection for the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.1.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to detect the cell before the  starts.

##### 9.4.4.1.2 Requirements

When the physical layer cell identities of neighbour cells together with the OTDOA assistance data are provided, the UE shall be able to detect and measure inter-RAT E-UTRAN FDD RSTD, specified in TS 38.215 [4], for at least *n*=16 cells, including the reference cell, within  ms as given below:

,

where

 is the total time for detecting and measuring at least *n* cells,

 is the largest value of the cell-specific positioning subframe configuration period, defined in TS 36.211 [23], among the measured *n* cells including the reference cell,

 is the number of PRS positioning occasions as defined in Table 9.4.4.1.2-1, where each PRS positioning occasion comprises of  (1≤≤6) consecutive downlink positioning subframes defined in TS 36.211 [23],

CSSFinterRAT=CSSFwithin\_gap,i is the scaling factor determined by the gap sharing scheme for the RSTD measurements on the carrier frequency *i* as defined in clause 9.1.5.2,

 =  ms is the measurement time for a single PRS positioning occasion which includes the sampling time and the processing time, and

the *n* cells are distributed on up to two E-UTRAN FDD carrier frequencies.

**Table 9.4.4.1.2-1: Number of PRS positioning occasions within **

|  |  |  |
| --- | --- | --- |
| Positioning subframe configuration period, | Number of PRS positioning occasions, | |
|  | f2 Note1 | f1 and f2 Note2 |
| 160 ms | 16 × CSSFinterRAT | 32 × CSSFinterRAT |
| >160 ms | 8 × CSSFinterRAT | 16 × CSSFinterRAT |
| NOTE 1: When inter-RAT E-UTRAN FDD RSTD measurements are performed over the reference cell and neighbour cells, which belong to the E-UTRAN FDD carrier frequency f2.  NOTE 2: When inter-RAT E-UTRAN FDD RSTD measurements are performed over the reference cell and the neighbour cells, which belong to the E-UTRAN FDD carrier frequency f1 and the E-UTRAN FDD carrier frequency f2 respectively. | | |

The UE physical layer shall be capable of reporting RSTD for the reference cell and all the neighbor cells *i* out of at least (*n*-1) neighbor cells within  provided:

≥-6 dB for all Frequency Bands for the reference cell,

≥-13 dB for all Frequency Bands for neighbour cell *i*,

 and  conditions apply for all subframes of at least  PRS positioning occasions,

PRP 1,2|dBm according to TS 36.133 [15, Annex B.2.6] for a corresponding Band,

 is defined as the ratio of the average received energy per PRS resource element during the useful part of the symbol to the average received power spectral density of the total noise and interference for this resource element, where the ratio is measured over all resource elements which carry PRS.

The time  starts from the first subframe of the PRS positioning occasion closest in time after both the *OTDOA-RequestLocationInformation* message and the OTDOA assistance data in the *OTDOA-ProvideAssistanceData* message via LPP as specified in TS 38.305 [22], are delivered to the physical layer of the UE.

The RSTD measurement accuracy for all measured neighbor cells *i* shall be fulfilled according to the accuracy as specified in clause 10.2.4.

9.4.4.1.2.1 RSTD Measurement Reporting Delay

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

9.4.4.1.2.2 Requirements for acquiring the timing of the E-UTRA OTDOA reference cell

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE supporting per-FR gaps may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells in FR1 for acquiring SFN of the reference cell in the E-UTRA OTDOA assistance data, while no autonomous gaps in downlink reception or uplink transmission are allowed in any of the UE serving cells in FR2. The UE, which are only supporting per-UE gaps, may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells for acquiring the SFN of the reference cell in the E-UTRA OTDOA assistance data.

When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps while indicating *eutra-FineTimingDetection* according to TS 38.331 [2] for detecting the reference cell in the E-UTRA OTDOA assistance data.

When the UE is performing one or both of SFN acquisition or cell detection as specified above, the UE shall be able to determine the timing of the E-UTRA OTDOA assistance data reference cell during the time period

TRefCell,E-UTRAN = TDetect, E-UTRAN FDD + TMIB + TECGI ,

where

TDetect, E-UTRAN FDD = TIdentify, E-UTRAN FDD - Tmeasure, E-UTRAN FDD is according to clause 9.4.2 assuming CSSFinterRAT=1 and it is the time needed to detect the E-UTRA OTDOA assistance data reference cell when the UE needs to acquire the subframe and slot timing of the cell, provided the UE is configured with measurement gaps (TDetect, E-UTRAN FDD=0 when both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset* are provided in the E-UTRA OTDOA assistance data or the E-UTRA OTDOA assistance data reference cell is known to the UE), and

TMIB = 50 ms is the time required to acquire SFN and/or PHICH configuration of the E-UTRA OTDOA assistance data reference cell provided the OTDOA assistance data reference cell is decodable and at least all E-UTRA subframes #0 during TMIB are available at the UE receiver (TMIB=0 when *nr-LTE-SFN-Offset* is provided in the E-UTRA OTDOA assistance data and ECGI acquisition is not needed), and

TECGI = 100 ms is the time required to acquire ECGI of the E-UTRA OTDOA assistance data reference cell when *cellGlobalId* is included in *OTDOA-ReferenceCellInfo* and the UE is not aware of the ECGI of this cell (TECGI = 0 when *cellGlobalId* is not included in *OTDOA-ReferenceCellInfo* or the UE is aware of the ECGI of the E-UTRA OTDOA assistance data reference cell).

When detecting the E-UTRAN OTDOA reference cell, the requirements in this clause shall be met, provided the conditions for the detectable cell are fulfilled according to clause 9.4.2.1. In addition, the MIB of the E-UTRA OTDOA reference cell whose SFN is acquired shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to TS 36.101 [25].

The requirement for acquiring the timing of the E-UTRA OTDOA reference cell within TRefCell,E-UTRAN is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

When TMIB>0 and UE is using autonomous gaps during TMIB, the UE shall transmit at least NACK/NACK, MIB, FDD ACK/NACKs on PCell, PSCell, and each of activated SCell(s) in the frequency range where the autonomous gaps are created, specified in Table 9.4.4.1.2.2-1. When both TMIB>0 and TECGI>0 and UE is using autonomous gaps during TMIB+TECGI, the UE shall transmit on PCell, PSCell, and each of activated SCell(s) in the frequency range where autonomous gaps are created at least NACK/NACK, MIB+ECGI, FDD ACK/NACKs specified in Table 9.4.4.1.2.2-3, provided the OTDOA reference cell bandwidth is configured in the OTDOA assistance data [22, 27]. The requirements in Tables 9.4.4.1.2.2-1, 9.4.4.1.2.2-2, and 9.4.4.1.2.2-3 apply, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured,

- SSBs are transmitted in one slot within SMTC window.

Table 9.4.4.1.2.2-2: Void

Table 9.4.4.1.2.2-2: Number of ACK/NACKs transmitted by the UE during TECGI

|  |  |  |
| --- | --- | --- |
| NACK/NACK, ECGI, FDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 66 | FDD | 15 kHz |
| 145 | FDD | 30 kHz |
| 298 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 67 | TDD Note 1 | 30 kHz |
| 144 | TDD Note 1 | 60 kHz |
| 175 | TDD Note 2 | 60 kHz |
| 363 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

Table 9.4.4.1.2.2-3: Number of ACK/NACKs transmitted by the UE during TMIB+TECGI

|  |  |  |
| --- | --- | --- |
| NACK/NACK, MIB+ECGI, FDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

#### 9.4.4.2 NR − E-UTRAN TDD RSTD measurements

##### 9.4.4.2.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSTD measurements requested via LPP [22, 27].

When the UE is in NE-DC operation mode and an NR−E-UTRAN TDD RSTD measurement configured by NR PCell is on a E-UTRA serving frequency carrier, then the corresponding E-UTRA intra-frequency measurements requirements as follows shall apply.

- Measurements configured on E-UTRA PSCC shall meet E-UTRAN OTDOA intra-frequency measurements requirements in clause 8.1.2.5. The applicable measurement accuracy requirements are in clause 9.1.10.

- Measurements configured on E-UTRA SCC shall meet all applicable requirements in clause 8.4, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC. The applicable measurement accuracy requirements are in clause 9.1.12, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC.

The requirements in clause 9.4.4.1 apply when:

- the UE is provided with the LTE timing information via LPP [27], including both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset*, or

- the UE is not provided with *nr-LTE-SFN-Offset* or *nr-LTE-fineTiming-Offset*, or

- the UE is provided with *nr-LTE-SFN-Offset* but not with *nr-LTE-fineTiming-Offset*.

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE may be using autonomous gaps to acquire SFN of the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.2.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to acquire the SFN before the  starts. When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps to perform cell detection for the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.2.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to detect the cell before the  starts.

##### 9.4.4.2.2 Requirements

When the physical layer cell identities of neighbour cells together with the OTDOA assistance data are provided, the UE shall be able to detect and measure inter-RAT -UTRAN TDD RSTD, specified in TS 38.215 [4], for at least *n*=16 cells, including the reference cell, within  ms as given below:

 ,

where

is the total time for detecting and measuring at least *n* cells,

 is the largest value of the cell-specific positioning subframe configuration period, defined in TS 36.211 [23], among the measured *n* cells including the reference cell,

 is the number of PRS positioning occasions as defined in Table 9.4.4.2.2-1, where a PRS positioning occasion is as defined in clause 9.4.4.1.2,

CSSFinterRAT=CSSFwithin\_gap,i is the scaling factor determined by the gap sharing scheme for the RSTD measurements on the carrier frequency *i* as defined in clause 9.1.5.2,

 =  ms is the measurement time for a single PRS positioning occasion which includes the sampling time and the processing time, and

the *n* cells are distributed on up to two E-UTRAN TDD carrier frequencies.

**Table 9.4.4.2.2-1: Number of PRS positioning occasions within **

|  |  |  |
| --- | --- | --- |
| Positioning subframe | Number of PRS positioning occasions, | |
| configuration period, | f2 Note1 | f1 and f2 Note2 |
| 160 ms | 16 × CSSFinterRAT | 32 × CSSFinterRAT |
| >160 ms | 8 × CSSFinterRAT | 16 × CSSFinterRAT |
| NOTE 1: When inter-RAT E-UTRAN TDD RSTD measurements are performed over the reference cell and neighbour cells, which belong to the E-UTRAN TDD carrier frequency f2.  NOTE 2: When inter-RAT E-UTRAN TDD RSTD measurements are performed over the reference cell and the neighbour cells, which belong to the E-UTRAN TDD carrier frequency f1 and the E-UTRAN TDD carrier frequency f2 respectively. | | |

The requirements in this clause shall apply for all TDD special subframe configurations specified in TS 36.211 [23] and for the TDD uplink-downlink configurations as specified in Table 9.4.4.2.2-2 for UE requiring measurement gaps for these measurements. For UEs capable of performing inter-RAT RSTD measurements without measurement gaps, TDD uplink-downlink subframe configurations as specified in Table 9.4.4.2.2-3 shall apply.

Table 9.4.4.2.2-2: TDD uplink-downlink subframe configurations applicable for inter-RAT RSTD requirements

|  |  |
| --- | --- |
| **PRS Transmission Bandwidth (RB)** | **Applicable TDD uplink-downlink configurations** |
| 6, 15 | 3, 4 and 5 |
| 25 | 1, 2, 3, 4, 5 and 6 |
| 50, 75, 100 | 0, 1, 2, 3, 4, 5 and 6 |
| NOTE 1: Uplink-downlink configurations are specified in Table 4.2-2 in TS 36.211 [23]. | |

**Table 9.4.4.2.2-3: TDD uplink-downlink subframe configurations applicable for inter-RAT RSTD requirements without gaps**

|  |  |
| --- | --- |
| **PRS Transmission Bandwidth (RB)** | **Applicable TDD uplink-downlink configurations** |
| 6, 15 | 1, 2, 3, 4 and 5 |
| 25, 50, 75, 100 | 0, 1, 2, 3, 4, 5 and 6 |
| NOTE 1: Uplink-downlink configurations are specified in Table 4.2-2 in TS 36.211 [23]. | |

The UE physical layer shall be capable of reporting RSTD for the reference cell and all the neighbor cells *i* out of at least (*n*-1) neighbor cells within  provided:

≥-6 dB for all Frequency Bands for the reference cell,

≥-13 dB for all Frequency Bands for neighbour cell *i*,

 and  conditions apply for all subframes of at least  PRS positioning occasions,

PRP 1,2|dBm according to TS 36.133 [15, Annex B.2.6] for a corresponding Band,

 is as defined in clause 9.4.4.1.2.

The time  starts from the first subframe of the PRS positioning occasion closest in time after both the OTDOA-RequestLocationInformation message and the OTDOA assistance data in the OTDOA-ProvideAssistanceData message via LPP as specified in TS 38.305 [22], are delivered to the physical layer of the UE.

The RSTD measurement accuracy for all measured neighbor cells *i* shall be fulfilled according to the accuracy as specified in clause 10.2.4.

9.4.4.2.2.1 RSTD Measurement Reporting Delay

This requirement assumes that that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

9.4.4.2.2.2 Requirements for acquiring the timing of the E-UTRA OTDOA reference cell

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE supporting per-FR gaps may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells in FR1 for acquiring SFN of the reference cell in the E-UTRA OTDOA assistance data, while no autonomous gaps in downlink reception or uplink transmission are allowed in any of the UE serving cells in FR2. The UE, which are only supporting per-UE gaps, may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells for acquiring the SFN of the reference cell in the E-UTRA OTDOA assistance data.

When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps while indicating *eutra-FineTimingDetection* according to TS 38.331 [2] for detecting the reference cell in the E-UTRA OTDOA assistance data.

When the UE is performing one or both of SFN acquisition or cell detection as specified above, the UE shall be able to determine the timing of the E-UTRA OTDOA assistance data reference cell during the time period

TRefCell,E-UTRAN = TDetect, E-UTRAN TDD + TMIB + TECGI ,

where

TDetect, E-UTRAN TDD = TIdentify, E-UTRAN TDD - Tmeasure, E-UTRAN TDD is according to clause 9.4.3 assuming CSSFinterRAT=1 and it is the time needed to detect the E-UTRA OTDOA assistance data reference cell when the UE needs to acquire the subframe and slot timing of the cell, provided the UE is configured with measurement gaps (TDetect, E-UTRAN TDD=0 when both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset* are provided in the E-UTRA OTDOA assistance data or the E-UTRA OTDOA assistance data reference cell is known to the UE), and

TMIB = 50 ms is the time required to acquire SFN and/or PHICH configuration of the E-UTRA OTDOA assistance data reference cell provided the OTDOA assistance data reference cell is decodable and at least all E-UTRA subframes #0 during TMIB are available at the UE receiver (TMIB=0 when *nr-LTE-SFN-Offset* is provided in the E-UTRA OTDOA assistance data and ECGI acquisition is not needed), and

TECGI = 100 ms is the time required to acquire ECGI of the E-UTRA OTDOA assistance data reference cell when *cellGlobalId* is included in *OTDOA-ReferenceCellInfo* and the UE is not aware of the ECGI of this cell (TECGI = 0 when *cellGlobalId* is not included in *OTDOA-ReferenceCellInfo* or the UE is aware of the ECGI of the E-UTRA OTDOA assistance data reference cell).

When detecting the E-UTRAN OTDOA reference cell, the requirements in this clause shall be met, provided the conditions for the detectable cell are fulfilled according to clause 9.4.3.1. In addition, the MIB of the E-UTRA OTDOA reference cell whose SFN is acquired shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to TS 36.101 [25].

The requirement for acquiring the timing of the E-UTRA OTDOA reference cell within TRefCell,E-UTRAN is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

When TMIB>0 and UE is using autonomous gaps during TMIB, the UE shall transmit at least NACK/NACK, MIB, TDD ACK/NACKs on PCell, PSCell, and each of activated SCell(s) in the frequency range where the autonomous gaps are created, specified in Table 9.4.4.2.2.2-1. When both TMIB>0 and TECGI>0 and UE is using autonomous gaps during TMIB+TECGI, the UE shall transmit on PCell, PSCell, and each of activated SCell(s) in the frequency range where autonomous gaps are created at least NACK/NACK, MIB+ECGI, TDD ACK/NACKs specified in Table 9.4.4.2.2.2-3, provided the OTDOA reference cell bandwidth is configured in the OTDOA assistance data [22, 27]. The requirements in Tables 9.4.4.2.2.2-1, 9.4.4.2.2.2-2 and 9.4.4.2.2.2-3 apply, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured,

- SSBs are transmitted in one slot within SMTC window.

Table 9.4.4.2.2.2-1: Minimum number of ACK/NACKs transmitted by the UE during TMIB

|  |  |  |
| --- | --- | --- |
| NACK/NACK, MIB, TDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 15 | FDD | 15 kHz |
| 39 | FDD | 30 kHz |
| 85 | FDD | 60 kHz |
| 0 | TDD Note 1 | 15 kHz |
| 4 | TDD Note 1 | 30 kHz |
| 12 | TDD Note 1 | 60 kHz |
| 46 | TDD Note 2 | 60 kHz |
| 104 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

Table 9.4.4.2.2.2-2: Void

Table 9.4.4.2.2.2-3: Minimum number of ACK/NACKs transmitted by the UE during TMIB+TECGI

|  |  |  |
| --- | --- | --- |
| NACK/NACK, MIB+ECGI, TDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

### 9.4.5 Inter-RAT E-CID measurements

#### 9.4.5.1 NR−E-UTRAN FDD E-CID RSRP and RSRQ measurements

##### 9.4.5.1.1 Introduction

The requirements in clause 9.4.5.1. shall apply provided the UE has received *ECID-RequestLocationInformation* message from LMF via LPP requesting the UE to report inter-RAT E-UTRAN FDD E-CID RSRP and RSRQ measurements [22, 27].

##### 9.4.5.1.2 Requirements

The requirements in clause 9.4.2 also apply for this clause except the measurement reporting requirements. The measurement reporting requirements for E-CID RSRP and RSRQ are defined in clause 9.4.5.1.3.

##### 9.4.5.1.3 Measurement Reporting Delay

This requirement assumes that that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

Reported RSRP and RSRQ measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2 and 10.2.3, respectively.

#### 9.4.5.2 NR−E-UTRAN TDD E-CID RSRP and RSRQ measurements

##### 9.4.5.2.1 Introduction

The requirements in clause 9.4.5.2. shall apply provided the UE has received *ECID-RequestLocationInformation* message from LMF via LPP requesting the UE to report inter-RAT E-UTRAN TDD E-CID RSRP and RSRQ measurements [22, 27].

##### 9.4.5.2.2 Requirements

The requirements in clause 9.4.3 also apply for this clause except the measurement reporting requirements. The measurement reporting requirements for E-CID RSRP and RSRQ are defined in clause 9.4.5.2.3.

##### 9.4.5.2.3 Measurement Reporting Delay

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

Reported RSRP and RSRQ measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2 and 10.2.3, respectively.

### 9.4.6 NR − UTRAN FDD measurements

#### 9.4.6.1 Introduction

The requirements are applicable for NR− UTRAN FDD CPICH RSCP and CPICH Ec/No measurements for SRVCC.

#### 9.4.6.2 Requirements when no DRX is used

9.4.6.2.1 Identification of a new UTRA FDD cell

When explicit neighbour list is provided and no DRX is used, either measurement gaps are scheduled or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable cell belonging to the monitored set within



A cell shall be considered detectable when

- CPICH Ec/Io > -20 dB,

- SCH\_Ec/Io > -17 dB for at least one channel tap and SCH\_Ec/Ior is equally divided between primary synchronisation code and secondary synchronisation code. When L3 filtering is used an additional delay can be expected.

9.4.6.2.2 UE UTRA FDD CPICH measurement capability

When measurement gaps are scheduled for UTRA FDD inter RAT measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting measurements to higher layers with measurement accuracy as specified in Clause 10 with measurement period given by



The UE shall be capable of performing UTRA FDD CPICH measurements for Xbasic measurementUTRA\_FDD inter-frequency cells per FDD frequency and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of TMeasurement\_ UTRA\_FDD.

Xbasic measurement UTRA\_FDD = 6

TMeasurement\_Period UTRA\_FDD = 480 ms. The period used for calculating the measurement period Tmeasurement\_UTRA\_FDD for UTRA FDD CPICH measurements.

Tbasic\_identify\_UTRA\_FDD  = 300 ms. This is the time period used in the inter RAT equation in clause 9.4.6.2.1 where the maximum allowed time for the UE to identify a new UTRA FDD cell is defined.

Tbasic\_measurement\_UTRA\_FDD = 50 ms. This is the time period used in the equation for defining the measurement period for inter RAT CPICH measurements.

CSSFinterRAT = CSSFwithin\_gap,i is the scaling factor for the measured inter-RAT UTRA carrier *i* which is calculated as specified in clause 9.1.5.2.

Tinter1 is defined in clause 9.4.1.

9.4.6.2.3 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in clause 10.

9.4.6.2.4 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in clause 10.

The UE shall not send any event triggered measurement reports, as long as the reporting criteria is not fulfilled.

The measurement reporting delay is defined as the time between any event that will trigger a measurement report until the UE starts to transmit the measurement report over the Uu interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is twice the TTI of the uplink DCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify, UTRA\_FDD defined in Clause 9.4.6.2.1 for the minimum requirements. When L3 filtering is used an additional delay can be expected.

If a cell which has been detectable at least for the time period Tidentify, UTRA\_FDD defined in clause 9.4.6.2.1 for the minimum requirements and then triggers the measurement report as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than Tmeasurement\_UTRA\_FDD defined in clause 9.4.6.2.2 provided the timing to that cell has not changed more than ± 32 chips while measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used, an additional delay can be expected.

9.4.6.2.5 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in clause 10.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.6.2.4 Event Triggered Reporting.

#### 9.4.6.3 Requirements when DRX is used

When explicit neighbour list is provided and DRX is used, either measurement gaps are scheduled or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable cell belonging to the neighbour cell list within Tidentify,UTRA\_FDD as shown in table 9.4.6.3-1

Table 9.4.6.3-1: Requirement to identify a newly detectable UTRA FDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | Tidentify\_UTRA\_FDD (s) (DRX cycles) | |
|  | Gap period = 40 ms | Gap period = 80 ms |
| ≤0.04 | Non DRX Requirements in clause 9.4.6.2 are applicable | Non DRX Requirements in clause 9.4.6.2 are applicable |
| 0.064 | 2.56 \*CSSFinterRAT (40\*CSSFinterRAT) | 4.8 \*CSSFinterRAT (75 \*CSSFinterRAT) |
| 0.08 | 3.2 \*CSSFinterRAT (40 \*CSSFinterRAT) | 4.8 \*CSSFinterRAT (60\* CSSFinterRAT) |
| 0.128 | 3.2 \*CSSFinterRAT (25\* CSSFinterRAT) | 4.8 \*CSSFinterRAT (37.5\* CSSFinterRAT) |
| 0.16 | 3.2 \*CSSFinterRAT (20 \*CSSFinterRAT) | 4.8 \*CSSFinterRAT (30 \*CSSFinterRAT) |
| 0.16<DRX-cycle≤2.56 | Note1 (20 \*CSSFinterRAT) | Note1  (20 \*CSSFinterRAT) |
| Note 1: Time depends upon the DRX cycle in use.  Note 2: CSSFinterRAT is as defined in clause 9.4.2.2. | | |

A cell shall be considered detectable provided following conditions are fulfilled: A cell shall be considered detectable when

- CPICH Ec/Io > -20 dB,

- SCH\_Ec/Io > -17 dB for at least one channel tap and SCH\_Ec/Ior is equally divided between primary synchronisation code and secondary synchronisation code. When L3 filtering is used an additional delay can be expected.

The UE shall be capable of performing RSCP and Ec/Io measurements of at least 6 UTRA cells per UTRA FDD carrier for up to 3 UTRA FDD carriers and the UE physical layer shall be capable of reporting RSCP and Ec/Io measurements to higher layers with the measurement period defined in table 9.4.6.3-2 when DRX is used, either measurement gaps are scheduled or the UE supports capability of conducting such measurements without gaps.

Table 9.4.6.3-2: Requirement to measure UTRA FDD cells

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | Tmeasure\_ UTRA\_FDD (s) (DRX cycles) | |
|  | Gap period = 40 ms | Gap period = 80 ms |
| ≤0.04 | Non DRX Requirements in clause 9.4.6.2 are applicable | Non DRX Requirements in clause 9.4.6.2 are applicable |
| 0.064 | 0.48\* CSSFinterRAT (7.5\* Nfreq\*CSSFinterRAT) | 0.8 \*CSSFinterRAT  (12.5 \*CSSFinterRAT) |
| 0.08 | 0.48 \*CSSFinterRAT  (6 \*CSSFinterRAT) | 0. 8\*CSSFinterRAT (10 \*CSSFinterRAT) |
| 0.128 | 0.64 \*CSSFinterRAT  (5 \*CSSFinterRAT) | 0. 8 \*CSSFinterRAT (6.25 \*CSSFinterRAT) |
| 0.128<DRX-cycle≤2.56 | Note1 (5 \*CSSFinterRAT) | Note1 (5 \*CSSFinterRAT) |
| Note 1: Time depends upon the DRX cycle in use.  Note 2: CSSFinterRAT is as defined in clause 9.4.2.2. | | |

The measurement accuracy for all measured cells shall be as specified in the clause 10.3.

9.4.6.3.1 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in clause 10.

9.4.6.3.2 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in clause 10.

The UE shall not send any event triggered measurement reports, as long as the reporting criteria is not fulfilled.

The measurement reporting delay is defined as the time between any event that will trigger a measurement report until the UE starts to transmit the measurement report over the Uu interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is twice the TTI of the uplink DCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify,UTRA\_FDD defined in Clause 9.4.6.3.When L3 filtering is used an additional delay can be expected.

If a cell which has been detectable at least for the time period Tidentify, UTRA\_FDD defined in clause 9.4.6.3and then triggers the measurement report as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than Tmeasurement\_UTRA\_FDD defined in clause 9.4.6.3 provided the timing to that cell has not changed more than ± 32 chips while measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used, an additional delay can be expected.

9.4.6.3.3 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in clause 10.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.6.3.2 Event Triggered Reporting.

### 9.4.7 NR – E-UTRAN measurements with autonomous gaps

#### 9.4.7.1 CGI identification of an E-UTRA cell with autonomous gaps

The requirements in this clause apply when the UE is configured with standalone NR, NE-DC or NR-DC. The UE shall identify and report the CGI when requested by an NR PCell for the purpose ‘reportCGI’. The UE may make autonomous gaps in downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3.1 in TS 38.331 [2]. If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, regardless of whether DRX is used or not, or regardless of whether SCell(s) are configured or not, the UE shall be able to identify a new CGI of E-UTRA cell within = 150 ms. This is the maximum allowed time for the UE to identify a new CGI of an E-UTRA cell, provided that the E-UTRA cell has been already identified by the UE.

A cell shall be considered identifiable following conditions are fulfilled:

- RSRP related side conditions given in Clause 9.1 in [15] are fulfilled for a corresponding Band,

- SCH\_RP and SCH Ês/Iot according to Annex B.2.2 in [15] for a corresponding Band

The MIB of an E-UTRA cell whose CGI is identified shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to [25].

The requirement for identifying a new CGI of an E-UTRA cell within is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.9.4.7.2 CGI reporting delay

The E-UTRA CGI reporting delay is defined as the time between a command that will trigger an E-UTRA CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and an additional 30ms margin.

## 9.4A Inter-RAT measurements for RedCap

### 9.4A.1 Introduction

The requirements in this clause are specified for NR−E-UTRAN FDD and NR−E-UTRAN TDD measurements and are applicable without an explicit E-UTRAN neighbour cell list containing physical layer cell identities, for a UE:

- in RRC\_CONNECTED state, and

- configured

- with SA operation mode by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR) on E-UTRA non-serving frequency carrier, and

- configured with an appropriate measurement gap pattern according to Table 9.1A.2-3.

Parameter TInter1\_RedCap used in inter-RAT requirements in clause 9.4A is specified in Table 9.4A.1-1.

Table 9.4A.1-1: Minimum available time for inter-RAT measurements

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1\_RedCap, ms) |
| 0 | 6 | 40 | 60 |
| 1 | 6 | 80 | 30 |
| 2 | 3 | 40 | 24Note 1 |
| 3 | 3 | 80 | 12Note 1 |
| 4 | 6 | 20 | 120 Note 1 |
| 6 | 4 | 20 | 72 Note 1,3,6 |
| 7 | 4 | 40 | 36 Note 1,4,6 |
| 8 | 4 | 80 | 18Note 1,5,6 |
| 10 | 3 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1\_RedCap for gap pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1\_RedCap = 60 for gap pattern IDs 2, 4, 6, 7, 10, and Tinter1\_RedCap = 30 for gap pattern IDs 3 and 8 shall be used.  NOTE 2: Measurement gaps pattern configurations applicability is as specified in Table [9.1A.2-1].  NOTE 3: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 48 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 4: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 24 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 5: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 12 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 6: This gap pattern is applicable for E-UTRA inter-frequency measurements only if gap based NR measurements are also configured. | | | |

A UE configured with gap pattern ID 2, 3 or 10 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends not later than 500 μs before the end of the measurement gap in case of FDD and not later than 750 μs before the end of measurement gap in case of TDD.

A UE configured with gap pattern ID 6, 7 or 8 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends no later than 1500 μs before the end of the measurement gap in case of FDD and no later than 1750 μs before the end of measurement gap in case of TDD.

In this clause, the SSB terminology applies for both CD-SSB and NCD-SSB.

### 9.4A.2 NR − E-UTRAN FDD measurements

#### 9.4A.2.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN FDD cell is considered to be detectable when:

*Editor’s note: New reference clauses shall be specified for 1Rx.*

- For 2 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

- For 1 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.3] of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.3] of TS 36.133 [15],

#### 9.4A.2.2 Requirements when no DRX is used

When the UE requires measurement gaps to identify and measure inter-RAT cells and an appropriate measurement gap pattern is scheduled, the UE shall be able to identify a new detectable FDD cell within TIdentify\_RedCap, E-UTRAN FDD according to the following expression:

,

where:

TBasicIdentify = 480 ms,

TInter1\_RedCap is defined in clause 9.4A.1,

CSSFinterRAT\_RedCap = CSSFwithin\_gap\_RedCap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1A.5.2.

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure\_RedCap, E-UTRAN FDD defined in Table 9.4A.2.2-1 and Table 9.4A.2.2-2 for 2 Rx RedCap UE and 1 Rx RedCap UE, respectively.

Table 9.4A.2.2-1: Measurement period and measurement bandwidth for 2Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure\_RedCap, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 480 x CSSFinterRAT\_RedCap | 6 |
| 1 (Note 1) | 240 x CSSFinterRAT\_RedCap | 50 |
| NOTE 1: This configuration is optional. | | |

Table 9.4A.2.2-2: Measurement period and measurement bandwidth for 1Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure\_RedCap, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 960 x CSSFinterRAT\_RedCap | 6 |
| 1 (Note 1) | 480 x CSSFinterRAT\_RedCap | 50 |
| NOTE 1: This configuration is optional. | | |

The UE shall be capable of identifying and performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD carrier frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers.

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.2.3 Requirements when DRX is used

When DRX is in use and measurement gaps are configured, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify\_RedCap, E-UTRAN FDD specified in Table 9.4A.2.3-1.

Table 9.4A.2.3-1: Requirement to identify a newly detectable E-UTRAN FDD cell

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify\_RedCap, E-UTRAN FDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4A.2.2 apply | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.256 | 5.12\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (30\*CSSFinterRAT\_RedCap) |
| 0.32 | 6.4\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (24\*CSSFinterRAT\_RedCap) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT\_RedCap) | Note1 (20\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure\_RedCap, E-UTRAN FDD specified in Table 9.4A.2.3-2 and Table 9.4A.2.3-3.

Table 9.4A.2.3-2: Requirement to measure E-UTRAN FDD cells for 2Rx RedCap UE

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure\_RedCap, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (5\* CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | |

Table 9.4A.2.3-3: Requirement to measure E-UTRAN FDD cells for 1Rx RedCap UE

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure\_RedCap, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (10\* CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | |

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.2.4 Measurement reporting requirements

##### 9.4A.2.4.1 Periodic Reporting

For 2 Rx RedCap UE: The requirements in clause 9.4.2.4.1 shall apply.

For 1 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

##### 9.4A.2.4.2 Event-Triggered Periodic Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4A.2.4.3.

##### 9.4A.2.4.3 Event-Triggered Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify\_RedCap, E-UTRAN FDD defined in clauses 9.4A.2.2 and 9.4A.2.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify\_RedCap, E-UTRAN FDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure\_RedCap, E-UTRAN FDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap has not been available and the L3 filter has not been used.

### 9.4A.3 NR − E-UTRAN TDD measurements

#### 9.4A.3.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN TDD cell is considered to be detectable when:

*Editor’s note: New reference clauses shall be specified for 1Rx.*

- For 2 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

- For 1 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4A.3.2 Requirements when no DRX is used

When the UE requires measurement gaps to identify and measure inter-RAT cells and an appropriate measurement gap pattern is scheduled, the UE shall be able to identify a new detectable TDD cell within TIdentify\_RedCap, E-UTRAN TDD according to the following expression:

- When configuration 0 or configuration 1 in Table 9.4A.3.2-1 is applied,

,

- When configuration 2 or configuration 3 in Table 9.4A.3.2-1 is applied,

,

where:

TBasicIdentify = 480 ms,

TInter1\_RedCap is defined in clause 9.4A.1,

CSSFinterRAT\_RedCap = CSSFwithin\_gap\_RedCap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1A.5.2.

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure\_RedCap, E-UTRAN TDD defined in Table 9.4A.3.2-1 and Table 9.4A.3.2-1 for 2 Rx RedCap UE and 1 Rx RedCap UE, respectively.

Table 9.4A.3.2-1: TMeasure\_RedCap, E-UTRAN TDD for different configurations for 2Rx RedCap UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure\_RedCap, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 480 x CSSFinterRAT\_RedCap |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 240 x CSSFinterRAT\_RedCap |
| 2 | 6 | 1 | 3 |  |  | 720 x CSSFinterRAT\_RedCap |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 480 x CSSFinterRAT\_RedCap |
| NOTE 1: This configuration is optional. | | | | | | |

Table 9.4A.3.2-2: TMeasure\_RedCap, E-UTRAN TDD for different configurations for 1Rx RedCap UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure\_RedCap, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 960 x CSSFinterRAT\_RedCap |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 480 x CSSFinterRAT\_RedCap |
| 2 | 6 | 1 | 3 |  |  | 1440 x CSSFinterRAT\_RedCap |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 960 x CSSFinterRAT\_RedCap |
| NOTE 1: This configuration is optional. | | | | | | |

The UE shall be capable of identifying and performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD carrier frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers.

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.3.3 Requirements when DRX is used

When DRX is in use and measurement gaps are configured, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify\_RedCap, E-UTRAN TDD specified in Table 9.4A.3.3-1.

Table 9.4A.3.3-1: Requirement to identify a newly detectable E-UTRAN TDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify\_RedCap, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause [9.4A.3.2] apply | Non-DRX requirements in clause [9.4A.3.2] apply |
| 0.256 | 5.12\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (30\*CSSFinterRAT\_RedCap) |
| 0.32 | 6.4\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (24\*CSSFinterRAT\_RedCap) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT\_RedCap) | Note1 (20\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause [9.4A.3.2]. | | |

For 1Rx RedCap UE, a cell shall be considered detectable provided following conditions are fulfilled:

- RSRP|dBm and RSRP Ês/Iot according to Annex B.2.3 in [15] for a corresponding Band,

- other RSRP related side conditions given in Clause 9.1.3.3 and 9.1.3.4 in [15] are fulfilled for a corresponding Band,

- RSRQ related side conditions given in Sections 9.1.6.5 and 9.1.6.6 in [15] are fulfilled for a corresponding Band,

- SCH\_RP|dBm SCH Ês/Iot according to Annex B.2.3 in [15] for a corresponding Band.

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure\_RedCap, E-UTRAN TDD specified in Table 9.4A.3.3-2 and Table 9.4A.3.3-3 for 2 Rx RedCap UE and 1 Rx RedCap UE, respectively.

Table 9.4A.3.3-2: Requirement to measure E-UTRAN TDD cells for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure\_RedCap, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause [9.4A.3.2] apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause [9.4A.3.2] apply,  Otherwise: Note1 (5\*CSSFinterRAT\_RedCap) |
| 0.128<DRX-cycle≤10.24 | Note1 (5\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.3.2.  NOTE 3: See Table [9.4A.3.2-1]. | |

Table 9.4A.3.3-3: Requirement to measure E-UTRAN TDD cells for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure\_RedCap, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause [9.4A.3.2] apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause [9.4A.3.2] apply,  Otherwise: Note1 (5\*CSSFinterRAT\_RedCap) |
| 0.128<DRX-cycle≤10.24 | Note1 (10\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.3.2.  NOTE 3: See Table [9.4A.3.2-1]. | |

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.3.4 Measurement reporting requirements

##### 9.4A.3.4.1 Periodic Reporting

For 2 Rx RedCap UE: The requirements in clause 9.4.3.4.1 shall apply.

For 1 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

##### 9.4A.3.4.2 Event-Triggered Periodic Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4A.3.4.3.

##### 9.4A.3.4.3 Event-Triggered Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify\_RedCap, E-UTRAN TDD defined in clauses 9.4A.3.2 and 9.4A.3.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify\_RedCap, E-UTRAN TDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure\_RedCap, E-UTRAN TDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap has not been available and the L3 filter has not been used.

### 9.4A.4 NR – E-UTRAN measurements with autonomous gaps

#### 9.4A.4.1 CGI identification of an E-UTRA cell with autonomous gaps

The requirements in this clause apply when the UE is configured with standalone NR with 2Rx UE. The UE shall identify and report the CGI when requested by an NR PCell for the purpose ‘reportCGI’. The UE may make autonomous gaps in downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3.1 in TS 38.331 [2].

For 2Rx RedCap UE: If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, the UE shall be able to identify a new CGI of E-UTRA cell within = 150 ms.

For 1Rx RedCap UE: If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, the UE shall be able to identify a new CGI of E-UTRA cell within = 190 ms.

This is the maximum allowed time for the UE to identify a new CGI of an E-UTRA cell, provided that the E-UTRA cell has been already identified by the UE.

A cell shall be considered identifiable following conditions are fulfilled:

- RSRP related side conditions given in Clause 9.1 in [15] are fulfilled for a corresponding Band,

- SCH\_RP and SCH Ês/Iot according to Annex B.2.2 in [15] for a corresponding Band

The MIB of an E-UTRA cell whose CGI is identified shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to [25].

The requirement for identifying a new CGI of an E-UTRA cell within is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

#### 9.4A.4.2 CGI reporting delay

The E-UTRA CGI reporting delay is defined as the time between a command that will trigger an E-UTRA CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and an additional 30ms margin.

#### 9.4A.4.3 CGI reporting scheduling restriction

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period Tidentify\_CGI\_RedCap, E-UTRA specified in clause 9.4A.4.1, the UE shall be able to transmit at least the number of ACK/NACKs specified in Table 9.4A.4.3-1 on PCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 9.4A.4.3-1: Minimum number of ACK/NACKs transmitted by the UE during Tidentify\_CGI\_RedCap, E-UTRA

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | SCS | |
|  | Duplex mode configuration | SCS |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

## 9.5 L1-RSRP measurements for Reporting

### 9.5.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for a serving cell, including PCell, PSCell, or SCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources, including the number of SSB resources of the cell with PCI different from serving cell configured for L1-RSRP measurements in 9.13, does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.5.2 Requirements applicability

The requirements in clause 9.5 apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.2 and 10.1.20.2 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

#### 9.5.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5.4 L1-RSRP measurement requirements

#### 9.5.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-1 for FR1. The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, and defined in Table 9.5.4.1-3 for FR2 power class 6 UE when *highSpeedMeasFlagFR2-r17* is configured, where

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

- N= 8 in Table 9.5.4.1-2.

When UE supports concurrent measurement gap and concurrent gaps are configured,

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

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 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 per-FR measurement gaps within the same FR as serving cell, 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

- TL1 is periodicity of the target SSB.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

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

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

For FR2,

P1=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is PL1\_sharing\*Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- P1=, when SSB is partially overlapped with GAP and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with GAP and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5\*TSMTCperiod

- P1=, when SSB is partially overlapped with GAP (TSSB < xRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

-

- If SSB resource from the cell with different PCI is configured for L1-RSRP measurement, and P2 is valid accoding to 9.13.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain)

- P = , if P1\*TSSB < P2\*TSSB\_CDP.

- P = P1, if P1\*TSSB > P2\*TSSB\_CDP.

- P = 2\*P1, if P1\*TSSB = P2\*TSSB\_CDP.

- Otherwise, P = P1

Where:

- TSSB = ssb-periodicityServingCell of the serving cell

- TSMTCperiod = the configured SMTC period

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside gap is

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

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

- Psharing factor = 3, otherwise.

- PL1\_sharing = 2, if SSB resource from the cell with different PCI is configured for L1-RSRP measurement, and Psharing\_factor,CDP is used in 9.13.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain). PL1\_sharing = 1, otherwise.

- TSSB = ssb-periodicityServingCell

- TSMTCperiod = the configured SMTC period

- If the UE is configured with Pre-MG, an SSB or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- an SSB or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- an SSB or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, an SSB or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

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

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

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

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: 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.  Note 2: K = 1 when TSSB ≤ 40 ms and *highSpeedMeasFlag-r16 or highSpeedMeasCA-Scell-r17* are configured; otherwise K = 1.5.  Note 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16. or measurementEnhancementCA-r17* | |

Table 9.5.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5.4.1-3: Measurement period TL1-RSRP\_Measurement\_Period\_SSB configured with *highSpeedMeasFlagFR2-r17* for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N1Note2)\*TSSB) |
| DRX cycle ≤ 80ms | max(TReport, ceil(M\*P\*N1Note2\*M2)\*max(TDRX,TSSB)) |
| 80ms< DRX ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note1: 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.  Note 2: N1 = 2 when *highSpeedMeasFlagFR2-r17* = set1; N1 = 6 when *highSpeedMeasFlagFR2-r17* = [set2].  Note 3: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

#### 9.5.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS is defined in Table 9.5.4.2-1 for FR1 and in Table 9.5.4.2-2 for FR2, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured with QCL-TypeD for all resources in the resource set.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided with QCL-TypeD for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided *qcl-info* is configured for all resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.19.2 and 10.1.20.2 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requirements apply provided *qcl-info* is configured with QCL-TypeD for all resources in the resource set.

When UE supports [concurrent measurement gap] and concurrent gaps are configured,

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

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 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 per-FR measurement gaps within the same FR as serving cell, 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 CSI-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

TL1 is periodicity of the target CSI-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

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

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

For FR2,

- P=1, when CSI-RS is not overlapped with a GAP and also not overlapped with SMTC occasion.

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=, when CSI-RS is not overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P=Psharing factor, when CSI-RS is not overlapped with GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=1, when aperiodic CSI-RS resource is not overlapped with GAP

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with GAP (TCSI-RS < xRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

Where:

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside gap is

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

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

- Psharing factor = 3, otherwise.

TSMTCperiod = the configured SMTC period.

TCSI-RS = the periodicity of CSI-RS configured for L1-RSRP measurement

If the UE is configured with Pre-MG, a CSI-RS or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CSI-RS or an SMTC occasion is considered to be as overlapped with the GAP if it overlapps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a CSI-RS or an SMTC occasion is considered to be as overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

When concurrent gaps are configured, a CSI-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

Table 9.5.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*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.  Note 3: K = 1 when TCSI-RS ≤ 40 ms and *highSpeedMeasFlag-r16 or highSpeedMeasCA-Scell-r17* are configured; otherwise K = 1.5.  Note 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16 or measurementEnhancementCA-r17.* | |

Table 9.5.4.2-2: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

### 9.5.4A Void

#### 9.5.4A.1 Void

Table 9.5.4A.1-1: Void

### 9.5.5 Measurement restriction for CSI-RS and SSB for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5.5.1 Measurement restriction for SSB based L1-RSRP

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

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

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

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

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

#### 9.5.5.2 Measurement restriction for CSI-RS based L1-RSRP

The SSB mentioned in this clause can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

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

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

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

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

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

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

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

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

- In the following cases, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and the other CSI-RS. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

- The CSI-RS for L1-RSRP measurement or the other CSI-RS in a resource set configured with repetition ON, or

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

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

- Otherwise, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

### 9.5.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions described in the following clauses apply when the UE is performing L1-RSRP measurement on serving cell, and UE is receiving PDCCH/PDSCH from serving cell and/or cell(s) with different PCI.

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

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

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

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

- 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.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which the serving cell where L1-RSRP measurement is performed is configured.

#### 9.5.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- For the case where RS for L1-RSRP measurement is CSI-RS which is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.5.4.2

- There are no scheduling restrictions due to L1-RSRP measurement performed based on the CSI-RS.

- Otherwise

- In non-HST scenario, for FR2-1 or the reference symbols to be measured for L1-RSRP is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

- For FR2-2 and the reference symbols to be measured for L1-RSRP is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and on one data symbol before and one data symbol after the symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and on one data symbol before and one data symbol after the symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and on one data symbol before and one data symbol after the symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered, and on one data symbol before and one data symbol after the symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

- In HST scenario, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement and 1 data symbol before each consecutive SSB symbols to be measured for L1-RSRP and 1 data symbol after each consecutive SSB symbols to be measured for L1-RSRP, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement and 1 data symbol before each periodic CSI-RS resource to be measured for L1-RSRP and 1 data symbol after each periodic CSI-RS for L1-RSRP measurement symbols to be measured for L1-RSRP, and/or

- symbols corresponding to the semi-persistent CSI-RS resource configured for L1-RSRP measurement and 1 data symbol before each semi-persistent CSI-RS resource to be measured for L1-RSRP and 1 data symbol after each semi-persistent CSI-RS resource to be measured for L1-RSRP when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement and 1 data symbol before each aperiodic CSI-RS resource to be measured for L1-RSRP measurement and 1 data symbol after each aperiodic CSI-RS resource to be measured for L1-RSRP measurement when the reporting is triggered.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to L1-RSRP measurement performed on FR2 serving cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

If following conditions are met,

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

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

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.5.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to L1-RSRP measurement performed on FR2 serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on FR1 serving cell(s).

## 9.5A L1-RSRP measurements for Reporting under CCA

### 9.5A.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured SSB resources for L1-RSRP. The measurements shall be performed for a serving cell under CCA operating mode, including PCell, PSCell, or SCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all SSB resources of the *csi-SSB-ResourceSet* within the *CSI-ResourceConfig* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

During EN-DC operation in FR-1, when the UE is configured to perform E-UTRA SRS carrier-based switching, an additional delay can be expected.

The requirements in clause 9.5A apply for any *channelAccessMode* configuration [TS 38.331, 2].

In the requirements of clause 9.5A, the term SSB occasion not available at the UE refers to when the SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SS/PBCH block index within the set of configured SSB are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation or measurement period; otherwise the SSB occasion is considered as available at the UE.

### 9.5A.2 Requirements applicability

The requirements in clause 9.5A apply, provided:

- The SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clause 10.1.19.1 for FR1 for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

An SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5A.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2-2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2-2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

During EN-DC operation, for FR1, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected if the UE is capable of per-FR gap, or an additional delay can be expected.

#### 9.5A.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2-2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5A.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2-2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

When CCA is used on target frequency, if UE cannot transmit HARQ-ACK for the MAC CE activation command due to UL CCA failure, the UE shall not perform MAC CE activation at the MAC action time based on the originally scheduled HARQ-ACK transmission time specified in clause 5.2.1.5.2 in TS 38.214 [26].

When CCA is used on target frequency, if UE cannot transmit HARQ-ACK for the MAC CE deactivation command due to UL CCA failure, the UE shall perform MAC CE deactivation at the MAC action time based on the originally scheduled HARQ-ACK transmission time specified in clause 5.2.1.5.2 in TS 38.214 [26].

#### 9.5A.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2-2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5A.4 L1-RSRP measurement requirements

#### 9.5A.4.1 SSB based L1-RSRP Reporting

The value of TL1-RSRP\_Measurement\_Period\_SSB\_CCA is defined in Table 9.5A.4.1-1 for FR1, and in Table 9.5A.4.1-2 for FR2-2, where,

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

- N = TBD

For FR1 when UE supports concurrent measurement gap and concurrent gaps configured,

- P value for an SSB resource to be measured is defined as Ntotal / Noutside\_MG

- 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 per-FR measurement gaps within the same FR as serving cell, 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 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

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

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

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

For FR2-2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

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

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- P=, when S SSB is partially overlapped with measurement gap (TSSB <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

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

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

- Psharing factor = 3, otherwise.

Where:

Psharing factor = 1, if the SSB resource outside gap is

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

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

Psharing factor = 3, otherwise.

TSSB = ssb-periodicityServingCell

TSMTCperiod = the configured SMTC1 period or SMTC2 period if configured

If the UE is configured with Pre-MG, an SSB is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured,

- an SSB is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- When NCSG is configured,

- an SSB is considered to be overlapped with the GAP if it overlaps the VIL1 or VIL2 of NCSG, and

- xRP = VIRP

- When concurrent gaps are configured, an SSB or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

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

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

UE shall report RSRP\_0 (Not valid) if L1>L1max, where L1 and L1max are defined in Table 9.5A.4.1-1.

Table 9.5A.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CCA for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CCA (ms) |
| non-DRX | max(TReport, ceil((M+L1)\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil((M+L1)\*P)\*TDRX |
| Note 1: 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.  Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise, when DRX is not configured L1 is the number of SSBs not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, and when DRX is configured L1 is the number of DRX cycles in which at least one SSB is not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, where L1 ≤ L1max. The UE is not required to determine the availability of SSB occasions more frequent than Once per Max(TReport, P \* TSSB) if no DRX is used,  Once per Max(TReport, Ceil(1.5 \* P) \* Max(TDRX, TSSB)) if DRX cycle ≤ 320ms,  Once per P \* TDRX if DRX cycle > 320ms.  Note 3: L1max =7 for Max(TDRX,TSSB) ≤ 40ms assuming TDRX=0 for non-DRX, L1max =5 for 40ms < Max(TDRX, TSSB) ≤ 320ms,  L1max =3 for TDRX > 320ms. | |

Table 9.5A.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CCA for FR2-2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CCA (ms) |
| non-DRX | max(TReport, ceil((M+L1)\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*(M+L1)\*P\*N)\*TDRX |
| Note 1: 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.  Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise, when DRX is not configured L1 is the number of SSB occasion groups not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, where L1 ≤ L1max. An SSB occasions group consists of N consecutive SSB occasions, and the SSB occasions group is not available at the UE when at least one SSB occasion in the group is not transmitted by the gNB. When DRX is configured, L1 is the number of DRX cycle groups in which at least one SSB occasion is not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, where L1 ≤ L1max. A DRX group consists of N DRX cycles, and the DRX cycle group is not available when there is at least one DRX in which at least one SSB occasion is not available. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.  Note 3: L1max =7 for Max(TDRX,TSSB) ≤ 40ms assuming TDRX=0 for non-DRX, L1max =5 for 40ms < Max(TDRX, TSSB) ≤ 320ms,  L1max =3 for TDRX > 320ms. | |

### 9.5A.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB for L1-RSRP without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

#### 9.5A.5.1 Measurement restriction for SSB based L1-RSRP

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

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure SSB for L1-RSRP measurement.

### 9.5A.6 Scheduling availability of UE during L1-RSRP measurement

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

#### 9.5A.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.5A.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- 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.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which the serving cell where L1-RSRP measurement is performed is configured.

#### 9.5A.6.3 Scheduling availability of UE performing L1-RSRP measurement in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on serving cell(s) under CCA.

#### 9.5A.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2-2

The following scheduling restriction applies due to L1-RSRP measurement on an FR2-2 serving PCell and/or PSCell.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

When intra-band carrier aggregation in FR2-2 is performed, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

For FR2-2, if following conditions are met,

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

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

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.5A.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to L1-RSRP measurement performed on FR2-2 serving cell(s) under CCA.

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on FR1 serving cell(s) under CCA.

## 9.5B L1-RSRP measurements for Reporting for RedCap

### 9.5B.1 Introduction

The applicability of the requirements for performing L1-RSRP measurements for reporting in subclause 9.5B is defined in Section 3.6. The SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified.

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for PCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.5B.2 Requirements applicability

The requirements in clause 9.5B apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

For 1 Rx RedCap:

- L1-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding band.

For 2 Rx RedCap:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

For 1 Rx RedCap:

- L1-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex TBD for a corresponding band.

For 2 Rx RedCap:

- L1-RSRP related side conditions given in clauses 10.1.19.2 and 10.1.20.2 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5B.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause TBD for FR1, for 1 Rx RedCap, and 10.1.19 for FR1 and 10.1.20 for FR2 for 2 Rx RedCap, if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause TBD for FR1, for 1 Rx RedCap, and 10.1.19 for FR1 and 10.1.20 for FR2 for 2 Rx RedCap. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in TBD for 1 Rx RedCap, and 10.1.6 for 2 Rx RedCap.

#### 9.5B.3.1 Periodic Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clause TBD for FR1.

For 2 Rx RedCap, reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5B.3.2 Semi-Persistent Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses TBD for FR1. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

For 2 Rx RedCap, reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5B.3.3 Aperiodic Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clause TBD.

For 2 Rx Redcap, reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5B.4 L1-RSRP measurement requirements

#### 9.5B.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5B.4.1-1 for FR1 and Table 9.5B.4.1-2 for FR2, for 2 Rx RedCap, and Table 9.5B.4.1-3 for FR1 for 1 Rx RedCap, where

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

- N= 8.

For FR1,

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

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

For FR2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

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

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- P=, when S SSB is partially overlapped with measurement gap (TSSB <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

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

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

- Psharing factor = 3, otherwise.

Where:

- TSSB = ssb-periodicityServingCell

- TSMTCperiod = the configured SMTC period

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

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

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

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5B.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5B.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5B.4.1-3: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

#### 9.5B.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap is defined in Table 9.5B.4.2-1 for FR1 and in Table 9.5B.4.2-2 for FR2, for 2 Rx RedCap, and in Table 9.5B.4.2-3 for 1 Rx RedCap, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured with QCL-TypeD for all resources in the resource set.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided with QCL-TypeD for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided *qcl-info* is configured for all resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.19.2 and 10.1.20.2 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requirements apply provided *qcl-info* is configured with QCL-TypeD for all resources in the resource set.

For FR1,

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

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

For FR2,

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

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- P=, when CSI-RS is not overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

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

- P=1, when aperiodic CSI-RS resource is not overlapped with measurement gap

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with measurement gap (TCSI-RS < MGRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

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

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside measurement gap is

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

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

- Psharing factor = 3, otherwise.

Where:

TSMTCperiod = the configured SMTC period.

TCSI-RS = the periodicity of CSI-RS configured for L1-RSRP measurement

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

Note: The overlap between CSI-RS for L1-RSRP measurement and SMTC means that CSI-RS for L1-RSRP measurement is within the SMTC window duration.

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

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

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5B.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

Table 9.5B.4.2-2: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

Table 9.5B.4.2-3: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

### 9.5B.5 Measurement restriction for CSI-RS and SSB for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5B.5.1 Measurement restriction for SSB based L1-RSRP

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

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

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

#### 9.5B.5.2 Measurement restriction for CSI-RS based L1-RSRP

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

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

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

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

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

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

### 9.5B.6 Scheduling availability of UE during L1-RSRP measurement

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

#### 9.5B.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

For FD-FDD and TDD RedCap UEs, there are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

For HD-FDD RedCap UE, scheduling restrictions apply for transmission on PUCCH/PUSCH/SRS during the CBD evaluation period, as CBD evaluation is prioritized over UL transmission. The CBD evaluation period equals the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap in case L1-RSRP measurement is performed on SSB as defined in clause 9.5B.4.1, or TL1‑RSRP\_Measurement\_Period\_CSI‑RS\_RedCap in case L1-RSRP measurement is performed on CSI-RS and/or SSB as defined in clause 9.5B.4.1.

#### 9.5B.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- For FD-FDD and TDD RedCap UEs, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

- For HD-FDD RedCap UE, scheduling restrictions apply for transmission on PUCCH/PUSCH/SRS during the CBD evaluation period, as CBD evaluation is prioritized over UL transmission. The CBD evaluation period equals the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap in case L1-RSRP measurement is performed on SSB as defined in clause 9.5B.4.1, or TL1‑RSRP\_Measurement\_Period\_CSI‑RS\_RedCap in case L1-RSRP measurement is performed on CSI-RS and/or SSB as defined in clause 9.5B.4.1.

#### 9.5B.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- For the case where RS for L1-RSRP measurement is CSI-RS which is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.5B.4.2

- There are no scheduling restrictions due to L1-RSRP measurement performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

If following conditions are met,

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

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

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

## 9.5C L1-RSRP measurements for Reporting for satellite access

### 9.5C.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for PCell on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

9.5C.2 Requirements applicability

The requirements in clause 9.5C apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.1 for FR1, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.2 for FR1, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5C.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

#### 9.5C.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses [FFS].

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5C.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses [FFS]. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5C.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses [FFS].

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5C.4 L1-RSRP measurement requirements

#### 9.5C.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_SAN.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_SAN is defined in Table 9.5C.4.1-1 for FR1, 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.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_SAN for FR1

|  |  |
| --- | --- |
| 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.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS is defined in Table 9.5C.4.2-1 for FR1, 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.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN for FR1

|  |  |
| --- | --- |
| 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.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5C.5.1 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.5.2 Measurement restriction for CSI-RS based L1-RSRP

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

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

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

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

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

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

### 9.5C.6 Scheduling availability of UE during L1-RSRP measurement

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

#### 9.5C.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

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

#### 9.5C.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

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

- 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.

## 9.6 NE-DC: Measurements

### 9.6.1 Introduction

This clause contains requirements for UE supporting dual connectivity with NR PCell and E-UTRA FDD or TDD PSCell. The requirements apply to UEs that have been configured with NE-DC.

### 9.6.2 SFTD Measurements

#### 9.6.2.1 Introduction

This clause contains requirements on UE capabilities for reporting of SFN and frame time difference between NR PCell and E-UTRA PSCell in RRC\_CONNECTED state. The requirements comprise measurement reporting delay and measurement accuracy. The overall measurement reporting delay includes a RRC procedure delay specified in TS 38.331 [2], and the SFTD measurement reporting delay specified below.

#### 9.6.2.2 SFTD Measurement requirements

When no DRX is used in either of the NR PCell and E-UTRA PSCell, the physical layer measurement period of the SFTD measurement shall be Tmeasure\_SFTD1 = max(0.2, 5 \* SMTC period) s.

When DRX is used in either of the NR PCell or the E-UTRA PSCell, or in both PCell and PSCell, the physical layer measurement period (Tmeasure\_SFTD1) of the SFTD measurement shall be as specified in Table 9.6.2.2-1.

Table 9.6.2.2-1: SFTD measurement requirement when DRX is used

|  |  |
| --- | --- |
| DRX cycle length (s)Note2 | Tmeasure\_SFTD1 (s) |
| DRX cycle≤0.04 | max(0.2,5 x SMTC period) (Note1) |
| 0.04<DRX cycle≤0.32 | 8 x max(DRX cycle, SMTC period) |
| 0.32<DRX cycle≤10.24 | 5 x DRX cycle |
| Note1: Number of DRX cycles depends upon the DRX cycle in use  Note2: DRX cycle length in this table refers to the DRX cycle length configured for PCell or PSCell. When DRX is used in both PCell and PSCell, DRX cycle length in this table refers to the longer of the DRX cycle lengths for PCell and PSCell. | |

If PSCell is changed without changing carrier frequency of PSCell while the UE is performing SFTD measurements, the UE shall still meet SFTD measurement and accuracy requirements for the new PSCell. In this case the UE shall restart the SFTD measurement, and the total physical layer measurement period shall not exceed Tmeasure\_SFTD2 as defined by the following expression:

Tmeasure\_SFTD2 = (M+1)\*(Tmeasure\_SFTD1) + M\*TPSCell\_change\_NEDC

where:

M is the number of times the E-UTRA PSCell is changed over the measurement period (Tmeasure\_SFTD2), and

TPSCell\_change\_NEDC is the time necessary to change the PSCell; it can be up to 25 ms.

If PCell is changed, or if PSCell is changed to a different carrier frequency, the UE shall terminate the SFTD measurement.

The measurement accuracy for the SFTD measurement when DRX is used as well as when no DRX is used shall be as specified in clause 10.1.21.1.

## 9.7 Cross Link Interference measurements

### 9.7.1 Introduction

The UE capable of performing CLI measurements shall be able to measure SRS-RSRP and CLI-RSSI which are defined in TS38.215 [4] within active DL BWP. The measurements requirements in this clause apply for TDD mode only.

CLI measurements are only applicable for RRC\_CONNECTED intra-frequency:

- when SRS-RSRP measurement resource is fully confined within BW of DL active BWP

- when CLI-RSSI measurement resouce is configured within active BWP

When the UE measures SRS-RSRP and CLI-RSSI, a constant offset relative to the downlink reference timing in the serving cell shall be applied. The constant offset value is derived by UE implementation and shall be at least Tc\*NTA\_offset.

For performing CLI measurement in FR2, UE can assume the configured CLI measurement resources are QCL-ed with TypeD to one of the latest received PDSCH and the latest monitored CORESET.

CLI measurement requirements defined in clause 9.7 are applicable if

- CLI measurement is not performed on an NR carrier in the same band as E-UTRA serving carrier; and

- UE supports simultaneous Rx/Tx for inter-band CA, inter-band EN-DC, inter-band NE-DC, and NR-DC.

### 9.7.2 SRS-RSRP measurements

#### 9.7.2.1 Introduction

When configured by the network, the UE shall be able to perform SRS-RSRP measurements of configured *srs-ResourceConfigCLI*. The requirements apply when the subcarrier spacing for SRS-RSRP measurement resource configuration is the same as the subcarrier spacing of the active DL BWP of serving cell. The UE is not required to measure SRS using different SCS compared to the downlink active BWP SCS of the same carrier.

#### 9.7.2.2 Requirements applicability

The requirements in clause 9.7.2 apply, provided:

- SRS resources configured for SRS-RSRP measurements are measurable.

An SRS resource configured for SRS-RSRP shall be considered measurable when for each relevant SRS the following conditions are met:

- SRS-RSRP related side conditions given in clauses 10.1.22.1 for FR1 and FR2 for a corresponding band,

- SRS\_RP and SRS Ês/Iot according to Annex B.2.7 for a corresponding band.

#### 9.7.2.3 Measurement Reporting Requirements

The UE shall send SRS-RSRP reports only for report configurations according to *reportType* which is *cliPeriodical* or *cliEventTriggered* when SRS-RSRP report is configured.

The UE shall report the SRS-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.22.1 for FR1 and FR2.

##### 9.7.2.3.1 Periodic Reporting

Reported SRS-RSRP measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.1.

##### 9.7.2.3.2 Event-triggered Periodic Reporting

Reported SRS-RSRP measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.22.1.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.7.2.3.3.

##### 9.7.2.3.3 Event Triggered Reporting

Reported SRS-RSRP measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.1.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report on.

#### 9.7.2.4 Measurement capability

The UE shall be capable of performing SRS-RSRP measurements on the SRS resources configured for measurement, provided that the number of SRS to be monitored by UE does not exceed 8 within a slot, and the total number of SRSs to be monitored by the UE does not exceed 32.

#### 9.7.2.5 SRS-RSRP measurement period

The UE shall be capable of performing SRS-RSRP measurement based on the configured SRS resource, and the UE shall be capable of reporting SRS-RSRP measured over measurement period of TSRS\_RSRP\_measurement\_period for FR1 and FR2.

Table 9.7.2.5‑1 Measurement period TSRS\_RSRP\_measurement\_period

|  |  |
| --- | --- |
| Configuration | TSRS\_measurement\_period (ms) |
| No DRX | Max(60, 3 X TSRS) |
| DRX cycle ≤ 320ms | Max(60, Ceil(1.5 X 3) X max(TSRS, TDRX)) |
| DRX cycle > 320ms | 3 X TDRX |
| Note: TSRS is SRS measurement periodicity configured *SRS-PeriodicityAndOffset*, and TDRX is the DRX cycle length. | |

If the SRS resources configured for measurement are partially or fully overlapping with SMTC window, SSB or CSI-RS configured for RLM, BFD, CBD or L1-RSRP measurement or measurement gaps, requirements are not specified for TSRS\_RSRP\_measurement\_period.

### 9.7.3 CLI-RSSI measurements

#### 9.7.3.1 Introduction

When configured by the network, the UE shall be able to perform CLI-RSSI measurement of configured *rssi-ResourceConfigCLI*. The subcarrier spacing for CLI-RSSI measurement resource configuration can be same or different from the subcarrier spacing of active BWP. UE shall perform CLI-RSSI measurement with the SCS of the active BWP.

#### 9.7.3.2 Requirements applicability

The requirements in clause 9.7.3 apply, provided:

- The measurement resources configured for CLI-RSSI measurements are measurable.

A measurement resource configured for CLI-RSSI shall be considered measurable when for each relevant CLI-RSSI resource the following conditions are met:

- CLI-RSSI related side conditions given in clauses 10.1.22.2 for FR1 and FR2 for a corresponding band.

#### 9.7.3.3 Measurement Reporting Requirements

The UE shall send CLI-RSSI reports only for report configurations according to *reportType* which is *cliPeriodical* or *cliEventTriggered* when CLI-RSSI report is configured.

The UE shall report the CLI-RSSI value as a 7-bit value in the range [-100, -25] dBm with 1dB step size according to clause 10.1.22.2 for FR1 and FR2.

##### 9.7.3.3.1 Periodic Reporting

Reported CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.2.

##### 9.7.3.3.2 Event-triggered Periodic Reporting

Reported CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.22.2.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.7.3.3.3.

##### 9.7.3.3.3 Event Triggered Reporting

Reported CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.2.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report on.

#### 9.7.3.4 Measurement capability

The UE should be capable of performing CLI-RSSI measurement based on the configured resource, provided that the maximum number of CLI-RSSI measurement resources for the UE does not exceed 64.

#### 9.7.3.5 CLI-RSSI measurement period

The UE shall be capable of performing CLI-RSSI measurement based on the configured measurement resource within TCLI\_RSSI\_measurement\_period. The UE shall be able to provide a single RSSI sample for each measurement resource configured for CLI-RSSI measurement occurring with a configured periodicity. The CLI-RSSI measurement period TCLI\_RSSI\_measurement\_period corresponds to the CLI-RSSI measurement resource periodicity, which is configured for by higher layers via *RSSI-PeriodicityAndOffset*.

If the CLI-RSSI measurement resources configured for measurement are partially or fully overlapping with SMTC window, SSB or CSI-RS configured for RLM, BFD, CBD or L1-RSRP measurement or measurement gaps, requirements are not specified for TCLI\_RSSI\_measurement\_period.

### 9.7.4 Scheduling availability of UE during CLI measurements

Scheduling availability restrictions when the UE is performing CLI measurements which are SRS-RSRP and CLI-RSSI are described in the following clause.

#### 9.7.4.1 Scheduling availability of UE performing measurement on FR1

The following scheduling restriction applies due to CLI measurements.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurements, and on 1 data symbol before an OFDM symbol used for CLI measurements for 15 kHz and 30 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurements, and on 1 data symbol before an OFDM symbol used for SRS-RSRP measurements for 15 kHz and 30 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurements, and on 1 data symbol before an OFDM symbol used for CLI-RSSI measurements for 15 kHz and 30 kHz subcarrier spacing.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurement, and on 2 data symbols before an OFDM symbol used for CLI measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurement, and on 2 data symbols before an OFDM symbol used for SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurement, and on 2 data symbols before an OFDM symbol used for CLI-RSSI measurements for 60 kHz subcarrier spacing.

When TDD intra-band carrier aggregation is configured, the scheduling restrictions on serving cell where CLI measurements are performed apply on all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

#### 9.7.4.2 Scheduling availability of UE performing measurement on FR2

The following scheduling restriction applies due to CLI measurements.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurements, and on 1 data symbol before an OFDM symbol used for CLI measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurements, and on 1 data symbol before an OFDM symbol used for SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurements, and on 1 data symbol before an OFDM symbol used for CLI-RSSI measurements for 60 kHz subcarrier spacing.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurements, and on 2 data symbols before an OFDM symbol used for CLI measurements for 120 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurements, and on 2 data symbols before an OFDM symbol used for SRS-RSRP measurements for 120 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurements, and on 2 data symbols before an OFDM symbol used for CLI-RSSI measurements for 120 kHz subcarrier spacing.

When TDD intra-band carrier aggregation is configured, the scheduling restrictions on serving cell where CLI measurements are performed apply on all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

## 9.8 L1-SINR measurements for Reporting

### 9.8.1 Introduction

When configured by the network, the UE shall be able to perform L1-SINR measurements with the measurement resources configured as the selection of:

- CSI-RS based CMR and no dedicated IMR configured;

- SSB based CMR and dedicated IMR configured;

- CSI-RS based CMR and dedicated IMR configured.

The measurements shall be performed for a serving cell, including PCell, PSCell, or SCell, on the resources configured for L1-SINR measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources and/or CSI-IM resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet and/or CSI-IM-ResourceSet* within the *CSI-ResourceConfig* settings for L1-SINR for the active BWP and measure interference on corresponding NZP CSI-RS or CSI-IM resources if configured, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.8.2 Requirements applicability

The requirements in clause 9.8 apply, provided:

- CMR resources configured for L1-SINR measurements are measurable, and

- NZP-IMR resources configured for L1-SINR measurements if applicable are measurable.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

For CSI-RS based CMR and no dedicated IMR configured, a CSI-RS resource configured for L1-SINR shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- L1-SINR related side conditions given in clauses 10.1.27 and 10.1.28 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.8.1 for a corresponding band.

For SSB based CMR and dedicated IMR configured, a SSB and a dedicated IMR configured for L1-SINR shall be considered measurable when for each relevant SSB and IMR the following conditions are met:

- L1-SINR related side conditions given in clauses 10.1.27 and 10.1.28 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.8.2 for a corresponding band.

- NZP-IMR Ês/Iot according to Annex B.2.8.2 for a corresponding band, if NZP-IMR is configured as dedicated IMR.

For CSI-RS based CMR and dedicated IMR configured, a CSI-RS and a dedicated IMR configured for L1-SINR shall be considered measurable when for each relevant CSI-RS and IMR the following conditions are met:

- L1-SINR related side conditions given in clauses 10.1.27 and 10.1.28 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.8.3 for a corresponding band

- NZP-IMR Ês/Iot according to Annex B.2.8.3 for a corresponding band, if NZP-IMR is configured as dedicated IMR.

### 9.8.3 Measurement Reporting Requirements

The UE shall send L1-SINR reports only for report configurations configured for the active BWP.

The UE shall report the L1-SINR value as a 7-bit value in the range [-23, 40] dB with 0.5dB step size if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-SINR based reporting. The differential L1-SINR is quantized to a 4-bit value with 1dB step size. The mapping between the reported L1-SINR value and the measured quantity is described in 10.1.16.

#### 9.8.3.1 Periodic Reporting

Reported L1-SINR measurements contained in periodic L1-SINR measurement reports shall meet the requirements in clauses 10.1.27 for FR1 and 10.1.28 for FR2, respectively.

The UE shall transmit the periodic L1-SINR reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.8.3.2 Semi-Persistent Reporting

Reported L1-SINR measurements contained in a Semi-Persistent L1-SINR measurement report shall meet the requirements in clauses 10.1.27 for FR1 and 10.1.28 for FR2, respectively. This requirement applies for semi-persistent L1-SINR reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-SINR measurement reports on PUSCH, if a DCI for triggering report has been received.

The UE shall only send semi-persistent L1-SINR measurement reports on PUCCH, if an activation command as described in clause 6.1.3.16 in TS38.321 [7] has been received.

The UE shall transmit the semi-persistent L1-SINR reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

9.8.3.3 Aperiodic Reporting

Reported L1-SINR measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-SINR reports shall meet the requirements in clauses 10.1.x for FR1 and 10.1.x for FR2, respectively.

The UE shall only send aperiodic L1-SINR measurement reports, if a DCI for triggering report has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-SINR reporting on PUSCH over the air interface at the time specified according to clause 5.2.1.4 in TS 38.214 [26].

### 9.8.4 L1-SINR measurement requirements

#### 9.8.4.1 L1-SINR reporting with CSI-RS based CMR and no dedicated IMR configured

edicated resource configured as IMR for L1-SINR computation, and the UE physical layer shall be capable of reporting L1-SINR measured over the measurement period of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only.

The value of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only is defined in Table 9.8.4.1-1 for FR1 and in Table 9.8.4.1-2 for FR2, where

For the value of M,

- For periodic and semi-persistent CSI-RS resources as CMR, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise;

- For aperiodic CSI-RS resources as CMR, M=1.

For the value of N in FR2

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured for all resources in the resource set.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requriements apply provided *qcl-info* is configured for all resources in the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.28.1 and 10.1.28.3 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requriements apply provided *qcl-info* is configured for all resources in the resource set.

When UE supports concurrent measurement gap and concurrent gaps are configured,

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

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 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 per-FR measurement gaps within the same FR as serving cell, 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 CSI-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target CSI-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For the value of P in FR1,

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

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

For the value of P in FR2,

- P=1, when CSI-RS is not overlapped with GAP and also not overlapped with SMTC occasion.

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=, when CSI-RS is not overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P is Psharing factor,, when CSI-RS is not overlapped with [measurement gap] and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with [measurement gap] (TCSI-RS < xRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP .

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

Where:

Psharing factor = 1, if the CSI-RS configured for L1-SINR measurement outside gap is

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

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

- Psharing factor = 3, otherwise.

- TSMTCperiod = the configured SMTC1 period or SMTC2 period if configured.

- TCSI-RS = the periodicity of CSI-RS configured for L1-SINR measurement

- If the UE is configured with Pre-MG, a CSI-RS reourse or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CSI-RS is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a CSI-RS is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, a CSI-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

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

Note: The overlap between CSI-RS for L1-SINR measurement and SMTC means that CSI-RS for L1-SINR measurement is within the SMTC window duration.

Longer evaluation period would be expected if the combination of CSI-RS, SMTC occasion and GAP configurations does not meet pervious conditions.

Table 9.8.4.1-1: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only for FR1

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only (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-SINR 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-SINR measurement is transmitted with Density = 3. | |

Table 9.8.4.1-2: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR 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-SINR measurement is transmitted with Density = 3. | |

9.8.4.2 L1-SINR reporting with SSB based CMR and dedicated IMR configured

The UE shall be capable of performing L1-SINR measurements with the SSB configured as CMR and dedicated resource configured as IMR for L1-SINR computation, in which the NZP-CSI-RS or CSI-IM resource configured as dedicated IMR shall be 1-to-1 mapped to SSB configured as CMR, with the same periodicity. The UE physical layer shall be capable of reporting L1-SINR measured over the measurement period of TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR.

The requirements in this clause are not applicable if NZP-CSI-RS or CSI-IM resource configured as dedicated IMR is scheduled with different periodicity as SSB configured as CMR.

The value of TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR is defined in Table 9.8.4.2-1 for FR1 and in Table 9.8.4.2-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, and defined in Table 9.8.4.2-3 for FR2 power class 6 UE when *highSpeedMeasFlagFR2-r17* is configured, where

For the value of M

- For periodic or semi-persistent NZP CSI-RS or CSI-IM resource as dedicated IMR, M=1 if the higher layer parameters *timeRestrictionForChannelMeasurements* and/or *timeRestrictionForInterferenceMeasurements* are configured, and M=3 otherwise;

For the value of N in FR2

- N = 8.

P is defined as the maximum value between PCMR and PIMR, i.e., P = max(PCMR, PIMR), where

- the value of PCMR shall be derived in the same way as the value of P used for SSB based L1-RSRP measurement in clause 9.5.4.1, in which the occasions and period of the SSB for CMR shall be used instead.

- the value of PIMR shall be derived in the same way as the value of P used for CSI-RS based L1-RSRP measurement in clause 9.5.4.2, in which the occasions and period of the NZP CSI-RS for NZP-IMR or CSI-IM for ZP-IMR shall be used instead.

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

For L1-SINR measurement with SSB as CMR and CSI-RS or CSI-IM as IMR, the requirement shall apply if the CSI-RS is configured as IMR with repetition field as “repetition = OFF” or CSI-IM is configured as IMR.

For L1-SINR measurement with SSB as CMR and CSI-RS/CSI-IM as IMR, no requirement shall apply if SSB occasions for CMR or CSI-RS/CSI-IM occasions for IMR are fully overlapped with the configured measurement gap

Table 9.8.4.2-1: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR1

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (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 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR channel 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 interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |

Table 9.8.4.2-2: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR 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 interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |

Table 9.8.4.2-3: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR configured with *highSpeedMeasFlagFR2-r17* for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N1Note 3)\*TSSB) |
| DRX cycle ≤ 80ms | max(TReport, ceil(M\*P\*N1Note 3\*M2)\*max(TDRX,TSSB)) |
| 80ms< DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR 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 interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity.  Note 3: N1 = 2 when *highSpeedMeasFlagFR2-r17* = set1; N1 = 6 when *highSpeedMeasFlagFR2-r17* = set2.  Note 4: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

#### 9.8.4.3 L1-SINR reporting with CSI-RS based CMR and dedicated IMR configured

The UE shall be capable of performing L1-SINR measurements with the CSI-RS resource configured as CMR and dedicated resource configured as IMR for L1-SINR computation, in which the NZP-CSI-RS or CSI-IM resource configured as dedicated IMR shall be 1-to-1 mapped to CSI-RS resource configured as CMR, with the same periodicity. The UE physical layer shall be capable of reporting L1-SINR measured over the measurement period of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR.

The requirements in this clause are not applicable if NZP-CSI-RS or CSI-IM resource configured as dedicated IMR is scheduled with different periodicity as CSI-RS resource configured as CMR.

The value of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR is defined in Table 9.8.4.3-1 for FR1 and in Table 9.8.4.3-2 for FR2, where

For the value of M,

- M=1 shall be applied if

- aperiodic NZP-CSI-RS as CMR or dedicated IMR, or

- aperiodic CSI-IMR as dedicated IMR, or

- periodic and semi-persistent NZP-CSI-RS as CMR or dedicated IMR and the higher layer parameters *timeRestrictionForChannelMeasurement* and/or *timeRestrictionForInterferenceMeasurements* are configured, or

- periodic and semi-persistent CSI-IM as dedicated IMR and the higher layer parameters *timeRestrictionForChannelMeasurement* and/or *timeRestrictionForInterferenceMeasurements* are configured;

- M=3 otherwise.

For the value of N in FR2

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured for all resources in the resource set.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requriements apply provided *qcl-info* is configured for all resources in the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.28.1 and 10.1.28.3 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requriements apply provided *qcl-info* is configured for all resources in the resource set.

P is defined as the maximum value between PCMR and PIMR, i.e., P = max(PCMR, PIMR), where

- The value of PCMR and PIMR shall be derived in the same way as the value of P used for CSI-RS based L1-RSRP measurement in clause 9.5.4.2, in which the occasions and period of the CSI-RS for CMR and NZP CSI-RS for NZP-IMR or CSI-IM for ZP-IMR shall be used instead respectively.

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

For L1-SINR measurement with CSI-RS as CMR and CSI-RS as IMR, the requirement shall apply only if CSI-RS resources as CMR and IMR are configured with the same repetition field and the number of CSI-RS resources in the resource sets for CMR and IMR are same.

For L1-SINR measurement with CSI-RS as CMR and CSI-IM as IMR, the requirement shall apply only if the number of CSI-RS resources in the resource set for CMR and the number of CSI-IM resources in the resource set for IMR are same.

For L1-SINR measurement with CSI-RS as CMR and CSI-RS/CSI-IM as IMR, no requirement shall apply if CSI-RS occasions for CMR or CSI-RS/CSI-IM occasions for IMR are fully overlapped with the configured measurement gap.

Table 9.8.4.3-1: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR1

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (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-SINR 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-SINR measurement is transmitted with Density = 3.  Note 3: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |

Table 9.8.4.3-2: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR 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-SINR measurement is transmitted with Density = 3.  Note 3: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |

### 9.8.5 Measurement restriction for L1-SINR measurement

The UE is required to be capable of measuring L1-SINR without measurement gaps. The UE is required to perform the SSB and CSI-RS/CSI-IM measurements with measurement restrictions as described in the following clauses.

#### 9.8.5.1 Measurement restriction if SSB configured for L1-SINR Measurement

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

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-SINR 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-SINR measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for L1-SINR measurement and CSI-RS. Longer measurement period for SSB based L1-SINR measurement is expected, and no requirements are defined.

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

For FR2, there is no measurement restriction allowed when the network configures mixed numerology between SSB configured as CMR for L1-SINR measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, provided that UE is capable of independent beam management on this FR2 band pair.

#### 9.8.5.2 Measurement restriction if CSI-RS configured for L1-SINR measurement

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

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

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

- If the UE supports *simultaneousRxDataSSB-DiffNumerology*, 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-SINR measurement and SSB. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

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

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

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

- In the following cases, UE is required to measure one of but not both CSI-RS for L1-SINR measurement and the other CSI-RS. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

- The CSI-RS for L1-SINR measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The CSI-RS or the other CSI-RS is configured as dedicated IMR for L1-SINR computation with SSB as CMR, or

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

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

- Otherwise, UE shall be able to measure the CSI-RS configured for L1-SINR measurement without any restriction.

#### 9.8.5.3 Measurement restriction if CSI-IM configured for L1-SINR measurement

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

For FR1, UE shall be able to measure the CSI-IM configured for L1-SINR measurement without any restriction.

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

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

- In the following cases, UE is required to measure one of but not both CSI-IM for L1-SINR measurement and CSI-RS. Longer measurement period for L1-SINR measurement is expected, and no requirements are defined.

- The CSI-RS in a resource set configured with repetition ON, or

- The CSI-IM or the CSI-RS is configured as dedicated IMR for L1-SINR computation with SSB as CMR, or

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

- The CMR for L1-SINR measurement and the CSI-RS are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-IM configured for L1-SINR measurement without any restriction.

### 9.8.6 Scheduling availability of UE during L1-SINR measurement

Scheduling availability restrictions when the UE is performing L1-SINR measurement are described in the following clauses.

#### 9.8.6.1 Scheduling availability of UE performing L1-SINR measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-SINR measurement performed on SSB and CSI-RS configured for L1-SINR measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.8.6.2 Scheduling availability of UE performing L1-SINR measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-SINR measurement based on SSB configured for L1-SINR measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-SINR measurement based on SSB configured for L1-SINR measurement.

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

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on serving cell where L1-SINR measurement is performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which the serving cell where L1-SINR measurement is performed is configured.

9.8.6.3 Scheduling availability of UE performing L1-SINR measurement on FR2

The following scheduling restriction applies due to L1-SINR measurement.

- For the cases of CSI-RS used for L1-SINR measurement of CSI-RS based CMR only case and CSI-RS based CMR plus CSI-RS based ZP-IMR/NZP-IMR case and CSI-RS based CMR plus ZP-IMR case, where CSI-RS is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.8.4

- There are no scheduling restrictions due to L1-SINR measurement performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the CSI-RS for L1-RSRP measurement symbols to be measured for L1-SINR for FR2 power class 6 UE which is not configured with *highSpeedMeasFlagFR2-r17*, and for the UE not supporting FR2 power class 6;

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the symbols to be measured for L1-SINR, and on 1 data symbol before symbols to be measured for L1-SINR and 1 data symbol after symbols to be measured for L1-SINR for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*.

When intra-band carrier aggregation is performed, the scheduling restrictions on serving cell where L1-SINR measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

If following conditions are met,

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

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

for the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-SINR measurement; and

for the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-SINR measurement.

#### 9.8.6.4 Scheduling availability of UE performing L1-SINR measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to L1-SINR measurement performed on FR2 serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) due to L1-SINR measurement performed on FR1 serving cell(s).

## 9.9 NR measurements for positioning

### 9.9.1 Introduction

This clause contains requirements for UE capable of performing NR positioning measurements defined in TS 38.215 [4], including RSTD, PRS-RSRP, UE Rx-Tx time difference, NR E-CID, and PRS-RSRPP measurements.

#### 9.9.1.1 General Aspects of Gap-based Measurement

For gap-based RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RSRPP measurements, the requirements in clauses 9.9.2.5, 9.9.3.5, 9.9.4.5 and 9.9.6.5 apply provided:

- the UE is configured or pre-configured with measurement gaps

- if the measurement gap is pre-configured, the gap must be activated throughout the measurement period, and

- if concurrent measurement gaps are configured, all positioning frequency layers are associated with only one of the measurement gaps, and

- if the UE does not support PRS measurements with per-FR gaps, the configured or pre-configured gap used to perform the PRS measurements must be of per-UE type, and

- No active BWP switching occurs during the measurement gaps for PRS measurement, and

All measurement requirements specified in clause 9.9.2.5, 9.9.3.5, 9.9.4.5 and 9.9.6.5 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

UE is only required to measure PRS resources that are fully or partially overlapped with measurement gaps, and the requirements in clause 9.9.2.5, 9.9.3.5, 9.9.4.5 and 9.9.6.5 are applicable to PRS resources that are fully or partially overlapped with measurement gaps.

A PRS resource is considered to be fully (partially) overlapped with measurement gaps if all (some) of its instances are overlapped with a measurement gap occasion. A PRS resource instance is considered to be overlapped with measurement gap occasion if the minimum number of unmuted repetitions of the instance taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD* is fully covered by the MGL excluding RF switching time, where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.38 for RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, respectively.

When UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

If a positioning measurement gap is configured via *PosGapConfig* and activated by MAC CE, the measurement requirements in clause 9.9.2.5, 9.9.3.5, 9.9.4.5 and 9.9.6.5 apply provided that no other MGs are configured, and only one measurement gap configured via *PosGapConfig* is activated.

#### 9.9.1.2 General Aspects of Gapless Measurement

The requirements for RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RSRPP measurement without measurement gaps specified in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 shall apply provided that:

UE is configured with PPW,

No active BWP switching occurs during PPW,

PRS is within PPW and does not overlap with other signals/channels of higher priority,

- for PPW type 1A/1B, the PPW does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

- for PPW type 2, PRS does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

max∣ΔT∣≤ THR, where

∆T is the time difference between the start of a slot containing PRS from the neighbor cell/TRP and the start of the closest slot from the serving cell;

the range of ∆T is determined by the expected RSTD and expected RSTD uncertainty in the assistance data;

THR is the threshold as reported in UE capability *prs-MeasurementWithoutMG-r17*.

SCS of PRS within PPW and SCS of DL active BWP are the same.

All measurement requirements specified in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

The UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.

The UE is only required to measure PRS resources that are unmuted and fully or partially overlapped with PPW, and the requirements in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 are applicable to PRS resources that are unmuted and fully or partially overlapped with PPW.

A PRS resource is considered to be fully (partially) overlapped with PPW if all (some) of its instances are overlapped with a PPW occasion. A PRS resource instance is considered to be overlapped with PPW occasion if the minimum number of unmuted repetitions of the instance taking into account Rx time difference between serving and non-serving cellis fully covered by the PPW , where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.38 for RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, respectively.

When UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

#### 9.9.1.3 Scheduling Availability of UE during PRS Measurement without Measurement Gaps

The requirements in this clause apply for UE performing RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP measurement without measurement gaps.

If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS on all symbols within PRS processing window.

If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS on all symbols within PRS processing window but is expected to receive PDCCH and URLLC PDSCH within PRS processing window.

If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS from a certain [band or CC] on all symbols within PRS processing window.

If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS from a certain [band or CC] but is expected to receive PDCCH and URLLC PDSCH from a certain [band or CC] on all symbols within PRS processing window.

If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on the symbols overlapped with DL PRS within PRS processing window.

If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS on the symbols overlapped with DL PRS within PRS processing window but is expected to receive PDCCH and URLLC PDSCH on the symbols overlapped with DL PRS within PRS processing window.

When PRS is lower priority than the DL signals/channels the following applies for cap1A and 1B UEs:

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW no later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the start of the PPW, UE expects to receive the DL signals/channels and drop all DL PRS in the PPW.

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the start of the PPW, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the DL PRS in the PPW.

When PRS is lower priority than the DL signals/channels the following applies for cap 2 UEs:

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol no later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the PRS symbol, UE expects to receive the DL signals/channels and drop the PRS symbol.

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the PRS symbol, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the PRS symbol.

For inter-band case for FR2 for the DL signals/channels from a different FR2 band than the FR2 band of the DL PRS, if the same Rx beam is used for both FR2 bands and the DL PRS is determined to be higher priority, capability 1B and 2 UEs are not expected to receive the DL signals/channels.

### 9.9.2 RSTD measurements

#### 9.9.2.1 Introduction

The requirements in clause 9.9.2 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report DL RSTD measurements defined in TS 38.215 [4].

#### 9.9.2.2 Requirements Applicability

The requirements in clause 9.9.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23 for FR1 and FR2 are fulfilled, for a corresponding Band.

#### 9.9.2.3 Measurement Capability

UE PRS RSTD measurement capability is as indicated by the UE in *NR-DL-TDOA-ProvideCapabilities*, according to TS 37.355[34].

#### 9.9.2.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported RSTD measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23, for each measured DL PRS resource.

##### 9.9.2.4.1 Void

##### 9.9.2.4.2 Void

##### 9.9.2.4.3 Void

#### 9.9.2.5 Measurements Period Requirements

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where ,

is the index of positioning frequency layer,

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below:

,

where:

is the UE Rx beam sweeping factor. In FR1, = 1;

and in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the carrier-specific scaling factor for NR PRS-based positioning measurements in positioning frequency layer *i* as defined in clause 9.1.5.2.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

- For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

- Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

- Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

- Requirements do not apply if Navailable =0.

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the number of PRS RSTD measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the

sampling time and processing time. If all of the PRS resources to be measured are available in the same MG occasion during Tavailabe, = +MGL. Otherwise, = + ,

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

*,* the least common multiple between and .

is the repetition periodicity of the measurement gap applicable for measurement in the PRS frequency layer i. is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where

is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

- Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34].

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* specified in TS 37.355 [34].

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time *s*tarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the physical layer of UE via LPP [34].

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the RSTD measurement in each reporting period and activate the location report at the time when the periodic timer expires.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured, the measurement period can be longer. When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period TRSTD,Total within measurement gaps due to collisions with other signals; otherwise, the measurement period can be longer.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements. The RSTD measurement period can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

#### 9.9.2.6 Void

#### 9.9.2.7 Measurements Period Requirements without Measurement Gaps

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

, if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2,

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i, and

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below.

,

where:

is the UE Rx beam sweeping factor. In FR1, = 1; and in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not supported *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of ,

only the PRS resources unmuted and fully or partially overlapped with PPW are considered, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the number of PRS RSTD measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- =2 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT* in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-*durationOfPRS*-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

, the least common multiple between and .

is the repetition periodicity of the PRS processing window applicable for measurements in the positioning frequency layer *i*.

is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*,

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating , only the PRS resources that meet the conditions for PRS measurement outside measurement gaps as defined in clause 9.9.1.2 are considered.

is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN* in TS 37.355 [34] if positioning frequency layer i is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer i is in Case 2.

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *ppw-maxNumOfDL-PRS-ResProcessedPerSlot* specified in TS 37.355 [34].

The time *s*tarts from the first instance of the activated PPW for measurement of positioning frequency layer *i* aligned with a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the physical layer of UE via LPP [34].

If during the measurement period of one or more positioning frequency layers, the PPW is re-configured or reactivated, the measurement period can be longer. When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period within PPW due to collisions with other signals; otherwise, the measurement period can be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements. The RSTD measurement period can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

#### 9.9.2.8 Void

#### 9.9.2.9 Measurements Period Requirements with both MG and PPW

If the UE is configured with both MG applicable to positioning measurement and PPW, the UE shall measure positioning frequency layer *i* within

- MG, if PRS resources on positioning frequency layer *i* are overlapped with MG, or

- PPW, if PRS resources on positioning frequency layer *i* are overlapped with PPW.

The measurement period is defined as:

,

Where

- is defined in clause 9.9.2.5 and includes all positioning frequency layers to be measured within MG,

- is defined in clause 9.9.2.7 and includes all positioning frequency layers to be measured within PPW,

- is the maximum Teffect defined in clauses 9.9.2.5 and 9.9.2.7 among all PFLs.

The requirements apply provided the following conditions are satisfied:

- MGs and PPWs do not overlap in time;

- Each PFL in the assistance data can be measured completely (all PRS resources) either within MG or within activated PPW.

### 9.9.3 PRS-RSRP measurements

#### 9.9.3.1 Introduction

The requirements in clause 9.9.3.5 shall apply provided the UE has received a message from LMF via LPP [34] requesting the UE to measure and report PRS-RSRP measurements defined in TS 38.215 [4].

#### 9.9.3.2 Requirements applicability

The requirements in clause 9.9.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1.24 are met for a corresponding Band.

#### 9.9.3.3 Measurement Capability

UE PRS-RSRP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

#### 9.9.3.4 Measurement Reporting Requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported PRS-RSRP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.24.3.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.24.

#### 9.9.3.5 Measurement Period Requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.3.3) PRS-RSRP measurements, defined in TS 38.215 [4], from configured PRS resources for configured TRPs on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is total number of positioning frequency layers,

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

where

is the carrier specific scaling factor for PRS-RSRP measurements specified in clause 9.1.5.2,

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

Requirements do not apply if Navailable =0.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and if positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS RSRP measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

*= +* is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time, if not all PRS resources to be measured are available in the same measurement gap occasion during , otherwise = + ,

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the measurement gap repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

When PRS-RSRP measurements are configured for DL-AoD, except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time starts from the first MG instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the PRS-RSRP measurement in each reporting period and activate the location report at the time when the periodic timer expires.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 9.9.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 9.9.4.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period within measurement gaps due to collisions with other signals; otherwise, a longer measurement period may be used.

The requirements in clause 9.9.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while PRS-RSRP measurements are being performed then the UE shall complete the ongoing PRS-RSRP measurements session. The PRS-RSRP measurement period can be longer. The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.24.

#### 9.9.3.6 Measurement Period Requirements without Measurement Gaps

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.3.3) PRS-RSRP measurements as defined in TS 38.215 [4] without measurement gap, on configured positioning frequency layer *i*, within ms.

if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2,

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i, and

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for PRS-RSRP measurement in positioning frequency layer *i* as specified below.

where

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of ,

only unmuted PRS resource instances that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *ppw-maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS RSRP measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 andall of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2

is the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the PRS processing window repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. If bitmap for higher-layer parameter *DL-* is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources that meet the applicability conditions and fully or partially covered by the PRS processing window are considered.

When PRS-RSRP measurements are configured for DL-AoD, the time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 9.9.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 9.9.4.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

if the PRS resource is across two sampling duration of N within duration or

if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If during the measurement period of one or more positioning frequency layers, the PPW is reconfigured or reactivated, the PRS-RSRP measurement period can be longer.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

#### 9.9.3.7 Void

#### 9.9.3.8 Measurements Period Requirements with both MG and PPW

If the UE is configured with both MG applicable to positioning measurement and PPW, the UE shall measure positioning frequency layer *i* within

- MG, if PRS resources on positioning frequency layer *i* are overlapped with MG, or

- PPW, if PRS resources on positioning frequency layer *i* are overlapped with PPW.

The measurement period is defined as:

,

Where

- is defined in clause 9.9.3.5 and includes all positioning frequency layers to be measured within MG,

- is defined in clause 9.9.3.6 and includes all positioning frequency layers to be measured within PPW,

- is the maximum Teffect defined in clauses 9.9.3.5 and 9.9.3.6 among all PFLs.

The requirements apply provided the following conditions are satisfied:

- MGs and PPWs do not overlap in time;

- Each PFL in the assistance data can be measured completely (all PRS resources) either within MG or within activated PPW.

### 9.9.4 UE Rx-Tx time difference measurements

#### 9.9.4.1 Introduction

The requirements in this clause shall apply, provided the UE has received *nr-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report one or more UE Rx-Tx time difference measurements defined in TS 38.215 [4].

#### 9.9.4.2 Requirements Applicability

The requirements in clause 9.9.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25 are met for a corresponding band.

- SRS is configured on at least one of the PCell, PSCell and SCell.

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

#### 9.9.4.3 Measurement Capability

UE Rx-Tx time difference measurement capability is as indicated by the UE in *NR-Multi-RTT-ProvideCapabilities,* according to TS 37.355 [34].

#### 9.9.4.4 Measurement Reporting Requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The UE Rx-Tx time difference measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.25.

The UE Rx-Tx time difference measurement accuracy for all measured DL PRS resourcesshall be fulfilled according to the accuracy requirements specified in clause 10.1.25.

#### 9.9.4.5 Measurement Period Requirements

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 9.9.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

*.*

where is the index of positioning frequency layer,

is the measurement period for UE Rx-Tx time difference measurements in positioning frequency layer *i* as further defined in this clause,

L is total number of positioning frequency layers, and

is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

Where

is the carrier-specific scaling factor for NR PRS-based measurement in the positioning frequency layer *i* as defined in clause 9.1.5.2,

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs or RxTx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

Requirements do not apply if Navailable =0.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and if positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in clause 4.2.7.2 of TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumOfDL-PRS-ResProcessedPerSlot* as specified in clause 6.4.3 of TS 37.355 [34],

is the number of UE Rx-Tx time difference measurement samples:

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples* defined in [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time,  *= +*  ,

is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

where

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

, the least common multiple between and

is the measurement gap repetition periodicity in positioning frequency layer *i*.

is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time starts from the first MG instance aligned with DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the PRS-RSRP measurement in each reporting period and activate the location report at the time when the periodic timer expires.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

The UE Rx-Tx time difference measurement period is restarted if HO occurs during the measurement period and after SRS reconfiguration on the target cell is complete.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period TUERxTx,Total within measurement gaps due to collisions with other signals; otherwise, a longer measurement period may be used.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 9.9.4 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

When PSCell or SCell addition or release does not cause SRS reconfiguration during the measurement period, UE continues the UE Rx-Tx time difference measurement, and the measurement period requirements apply.

When PSCell or SCell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

When SRS is reconfigured without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration is complete.If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

When a serving cell change occurs during the measurement period, the UE shall continue and complete the UE Rx-Tx time difference measurement provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx time difference measurement.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the UE autonomous timing adjustment defined in clause 7.1.2 during the UE Rx-Tx measurement period, then:

- UE Rx-Tx measurement period requirements in this clause shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission.

- UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.

#### 9.9.4.6 Measurement Period Requirements without Measurement Gaps

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 9.9.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

, if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2*.*

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i, and

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for UE Rx-Tx time difference measurement in positioning frequency layer *i* as specified below.

Where

is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not supported *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs or RxTx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of ,

only the unmuted PRS resources that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

- is UE capability for number of DL PRS resources that it can process in a slot corresponding to *ppw-maxNumOfDL-PRS-ResProcessedPerSlot* as specified in clause 6.4.3 of TS 37.355 [34],

- is the number of UE Rx-Tx time difference measurement samples:

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples* defined in [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

- is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

- is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

where

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT*  in TS 37.355 [34]if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

, the least common multiple between and

is the PRS processing window repetition periodicity in positioning frequency layer *i*.

is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

Note: For the purpose of calculating TPRS,i, only the PRS resources that meet the applicability conditions and fully or partially covered by the PRS processing window are considered.

The time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

The UE Rx-Tx time difference measurement period is restarted if HO occurs during the measurement period and after SRS reconfiguration on the target cell is complete.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the PRS processing window is reconfigured or reactivated either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period within PRS processing window due to collisions with other signals; otherwise, a longer measurement period may be used.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 9.9.4.6 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

When PSCell or SCell addition or release does not cause SRS reconfiguration during the measurement period, UE continues the UE Rx-Tx time difference measurement, and the measurement period requirements apply.

When PSCell or SCell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the UE autonomous timing adjustment defined in clause 7.1.2 during the UE Rx-Tx measurement period, then:

- UE Rx-Tx measurement period requirements in this clause shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission.

- UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

#### 9.9.4.7 Void

#### 9.9.4.8 Measurements Period Requirements with both MG and PPW

If the UE is configured with both MG applicable to positioning measurement and PPW, the UE shall measure positioning frequency layer *i* within

- MG, if PRS resources on positioning frequency layer *i* are overlapped with MG, or

- PPW, if PRS resources on positioning frequency layer *i* are overlapped with PPW.

The measurement period is defined as:

,

Where

- is defined in clause 9.9.4.5 and includes all positioning frequency layers to be measured within MG,

- is defined in clause 9.9.4.6 and includes all positioning frequency layers to be measured within PPW,

- is the maximum Teffect defined in clauses 9.9.4.5 and 9.9.4.6 among all PFLs.

The requirements apply provided the following conditions are satisfied:

- MGs and PPWs do not overlap in time;

- Each PFL in the assistance data can be measured completely (all PRS resources) either within MG or within activated PPW.

### 9.9.5 E-CID measurements

#### 9.9.5.1 Introduction

The requirements in clause 9.9.5 shall apply provided the UE has received *nr-ECID-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to report one or more of the following measurements for NR E-CID positioning [22]: SS-RSRP, SS-RSRQ, CSI-RSRP, and CSI-RSRQ.

#### 9.9.5.2 Measurement Requirements

##### 9.9.5.2.1 Intra-frequency Measurement Requirements

The intra-frequency NR E-CID measurements shall meet the requirements in clause 9.2 and clause 9.10.2, except the measurement reporting requirements. The NR E-CID measurement reporting requirements are defined in clause 9.9.5.2.3.

The reported intra-frequency NR E-CID measurements shall also meet:

- for FR1 SS-RSRP, the accuracy requirements in clauses 10.1.2.1,

- for FR1 SS-RSRQ, the accuracy requirements in clauses 10.1.7.1,

- for FR1 CSI-RSRP, the accuracy requirements in clause 10.1.2.3,

- for FR1 CSI-RSRQ, the accuracy requirements in clause 10.1.7.2,

- for FR2 SS-RSRP, the accuracy requirements in clauses 10.1.3.1,

- for FR2 SS-RSRQ, the accuracy requirements in clauses 10.1.8.1,

- for FR2 CSI-RSRP, the accuracy requirements in clause 10.1.3.3,

- for FR2 CSI-RSRQ, the accuracy requirements in clause 10.1.8.2.

##### 9.9.5.2.2 Inter-frequency Measurement Requirements

The inter-frequency NR E-CID measurements shall meet the requirements in clause 9.3 and 9.10.4, except the measurement reporting requirements. The NR E-CID measurement reporting requirements are defined in clause 9.9.5.2.3.

The reported inter-frequency NR E-CID measurements shall also meet:

- for FR1 SS-RSRP, the accuracy requirements in clauses 10.1.4.1,

- for FR1 SS-RSRQ, the accuracy requirements in clauses 10.1.9.1,

- for FR1 CSI-RSRP, the accuracy requirements 10.1.4.3,

- for FR1 CSI-RSRQ, the accuracy requirements 10.1.9.2,

- for FR2 SS-RSRP, the accuracy requirements in clauses 10.1.5.1,

- for FR2 SS-RSRQ, the accuracy requirements in clauses 10.1.10.1,

- for FR2 CSI-RSRP, the accuracy requirements 10.1.5.3,

- for FR2 CSI-RSRQ, the accuracy requirements 10.1.10.2.

##### 9.9.5.2.3 Measurement Reporting Delay

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported NR E-CID measurement values contained in periodically triggered measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.6 for SS-RSRP and CSI-RSRP, and clause 10.1.11 for SS-RSRQ and CSI-RSRQ.

The UE shall not send any measurement reports as long as no corresponding reporting criteria specified in clause 9.1.4 are fulfilled.

### 9.9.6 PRS-RSRPP measurements

#### 9.9.6.1 Introduction

The requirements in clause 9.9.6.5 shall apply when UE is performing PRS measurement in the configured MG and provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4].

The requirements in clause 9.9.6.6 shall apply when UE is performing PRS measurement without gap and provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4].

#### 9.9.6.2 Requirements applicability

The requirements in clause 9.9.6 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1.38 are met for a corresponding Band.

#### 9.9.6.3 Measurement capability

UE PRS-RSRPP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

#### 9.9.6.4 Measurement reporting requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes the delay uncertainty caused by inserting the measurement report into the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.38.3.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.38.2.

#### 9.9.6.5 Measurement period requirements

For PRS measurement within MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9.3.5 is re-used for PRS-RSRPP.

#### 9.9.6.6 Measurement Period Requirements without Measurement Gaps

For PRS measurement without MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9.3.6 is re-used for PRS-RSRPP.

The PRS-RSRPP measurement requirements in this section apply for the first path PRS-RSRP measurement.

#### 9.9.6.7 Void

#### 9.9.6.8 Measurements Period Requirements with both MG and PPW

If the UE is configured with both MG applicable to positioning measurement and PPW, the measurement period requirements for PRS-RSRP defined in 9.9.3.8 is re-used for PRS-RSRPP.

## 9.10 CSI-RS based L3 measurements

### 9.10.1 Introduction

This clause contains general requirements on the UE regarding CSI-RS based measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency and inter-frequency measurements requirements.

The requirements in this clause apply, provided:

- Only one MO is configured per CSI-RS frequency layer, and

- all CSI-RS resources in the same MO are configured with the same csi-rs-MeasurementBW, and

- *associatedSSB* is configured in *CSI-RS-Resource-Mobility* and detectable, and

- all CSI-RS resources in the same MO are configured with the same periodicity, and- the associated SSB is QCLed with the corresponding CSI-RS resources in FR2, and

- the number of CSI-RS resources in any duration that equals to the length of a slot is no larger than UE capability *maxNumberCSI-RS-RRM-RS-SINR*.

- When there are mixed numerologies, the length of a slot is defined based on the smallest SCS

### 9.10.2 CSI-RS based intra-frequency measurements

#### 9.10.2.1 Introduction

A measurement is defined as a CSI-RS based intra-frequency measurement provided that:

- the SCS of the CSI-RS resource of the neighbour cell configured for measurement is the same as the SCS of the CSI-RS resource on the serving cell indicated for measurement, and

- the CP type of the CSI-RS resource of neighbour cell configured for measurement is the same as the CP type of the CSI-RS resource of the serving cell indicated for measurement, and

- It is applied for SCS = 60KHz

- the centre frequency of the CSI-RS resource of the neighbour cell configured for measurement is the same as the centre frequency of the CSI-RS resource of the serving cell indicated for measurement

The UE shall be able to identify new intra-frequency cells and perform CSI-RSRP, CSI-RSRQ and CSI-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell or the PSCell.

No measurement gap is needed for intra-frequency CSI-RS resources measurements.

For intra-frequency CSI-RS based measurements, UE may cause scheduling restriction as specified in clause 9.10.2.6.

Note: Extended CP for CSI-RS based measurement is not supported in this release.

#### 9.10.2.2 Requirements applicability

The measurement of the associated SSB follows the same requirements as SSB based measurements defined in 9.2.

The requirements in clause 9.10.2 apply, provided:

- Only one intra-frequency CSI-RS layer per serving cell is configured, and

- The BW of the CSI-RS on the intra-frequency neighbor cell is within the active BWP of the UE, and

- The associated SSB of the CSI-RS resources being identified or measured are detectable, and the CSI-RS resources configured for CSI-RS based L3 measurements are measurable, and

- The bandwidth of CSI-RS resources of intra-MO is the same as that of the CSI-RS resources configured for the serving cell, and

- All CSI-RS resources on one intra-frequency layer are configured within up to two separate windows where each window is up to 5ms, and

- for the case of single window further provided

- The periodicity of the configured CSI-RS resources is 10ms, 20ms or 40ms- for the case of two separate windows further provided

- The two windows are either both fully non-overlapped with MG or both partially overlapped with MG

- The periodicity of the configured CSI-RS resources is 20ms or 40ms

- The starting point of the first window is the slot boundary of the serving cell, where the corresponding slot contains the configured L3 CSI-RS resource of the serving cell in the servingCellMO with the smallest offset, and

- The starting point of the second window if configured is determined by an offset of half of the CSI-RS periodicity in slots with regards to the starting point of the first window, and

- Numerology for intra-frequency CSI-RS and data of serving cell are the same.

An intra-frequency cell shall be considered detectable when for each relevant associated SSB:

- SS-RSRP related side conditions given in clauses 10.1.2.1 and 10.1.3.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7.1 and 10.1.8.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12.1 and 10.1.13.1 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

A CSI-RS resource shall be considered measurable when for each relevant CSI-RS resource:

- CSI-RSRP related side conditions given in clauses 10.1.2.3 and 10.1.3.3 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-RSRQ related side conditions given in clauses 10.1.7.2 and 10.1.8.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-SINR related side conditions given in clauses 10.1.12.2 and 10.1.13.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI\_RP and CSI-RS Ês/Iot according to Annex B.2.12 for a corresponding Band.

#### 9.10.2.3 Number of cells and number of CSI-RS

##### 9.10.2.3.1 Requirements for FR1

For each intra-frequency CSI-RS layer, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 32 CSI-RSs with different CSI-RS index and/or PCI on the intra-frequency layer, and

- the cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer of the associated SSB

##### 9.10.2.3.2 Requirements for FR2

For one single intra-frequency CSI-RS layer in a band, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 32 CSI-RSs with different CSI-RS index and/or PCI, and

- the cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer of the associated SSB.

where this single intra-frequency layer shall be:

- PCC on which UE is configured to report CSI-RS measurement when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC on which UE is configured to report CSI-RS measurement when UE is configured with EN-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report CSI-RS based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with CSI-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least 2 CSI-RSs on serving cell for each of the other intra-frequency layer(s) in the same band.

For each FR2 band, UE is only required to measure neighbour cell CSI-RS on the CSI-RS layer, whose associated SSB should be on the same SSB layer as the one where UE is required to measure neighbour cell SSB.

#### 9.10.2.4 Measurement Reporting Requirements

Note: The UE is not required to report CSI-RS based L3 measurements when the timing offset between the reference measurement timing and the target CSI-RS in one layer is larger than one CP. If the UE reports CSI-RS based L3 measurements when the timing offset exceeds one CP, the UE may not meet the CSI-RS based L3 measurement accuracy requirements for CSI-RSRP, CSI-RSRQ and CSI-SINR in TS 38.133 section 10.1, which apply only when the timing offset is no larger than one CP.

##### 9.10.2.4.1 Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses 10.1.2.3, 10.1.3.3, 10.1.7.2, 10.1.8.2, 10.1.12.2 and 10.1.13.2.

##### 9.10.2.4.2 Event-triggered Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.1.2.3, 10.1.3.3, 10.1.7.2, 10.1.8.2, 10.1.12.2 and 10.1.13.2.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.10.2.4.3.

##### 9.10.2.4.3 Event Triggered Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI- SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.2.3, 10.1.3.3, 10.1.7.2, 10.1.8.2, 10.1.12.2 and 10.1.13.2.

The UE shall not send any event triggered measurement reports as long as no reporting criterion is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than the CSI-RS based measurement defined in clause 9.10.2.5. When L3 filtering is used an additional delay can be expected.

#### 9.10.2.5 Intra-frequency measurements without measurement gaps

If a UE is configured with the higher layer parameters *CSI-RS-Resource-Mobility* and *associatedSSB*, the CSI-RS based measurement shall include PSS/SSS detection time of associatedSSB, the time period used to acquire the SFN information and CSI-RS based measurement period without gap.

- PSS/SSS detection time of associatedSSB is the intra-frequency TPSS/SSS\_sync\_intra in Clause 9.2.5.1.

- The time period used to acquire the SFN information is equal to 0 if the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise, the time period used to acquire the SFN information is TCSI-RS\_SFN\_intra as shown in Table 9.10.2.5-3 for FR1. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

- If the associatedSSB, which has been detectable at least for the time period Tidentify\_intra\_with\_index defined in clause 9.2.5.1, becomes undetectable for a period ≤ 5 seconds and then the associatedSSB becomes detectable again with the same spatial reception parameter provided the timing to that cell has not changed more than  3200/ Tc, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3], PSS/SSS detection time and time period used to acquire the SFN information are equal to 0.

The measurement period for CSI- RS based intra-frequency measurements without gaps is as shown in table 9.10.2.5-1and Table 9.10.2.5-2.

Additionally, for a given CSI-RS resource, if the associated SS/PBCH block is configured but not detected by the UE, or if CSI-RS is configured with associated SSB but not QCL-ed to the associated SSB, the UE is not required to monitor the corresponding CSI-RS resource.

Table 9.10.2.5-1: Measurement period for intrafrequency CSI-RS based measurements without gaps(FR1)

|  |  |
| --- | --- |
| DRX cycle | T CSI-RS\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kp\_CSI-RS) x CSI-RS period) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp\_CSI-RS) x max(CSI-RS period, DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp\_CSI-RS) x DRX cycle x CSSFintra |
| NOTE 1: The requirements apply assuming CSI-RS configuration with {D=3 with PRBs ≥ 48}. D is frequency domain density for the 1-port CSI-RS for L3 mobility defined in clause 7.4.1 of TS38.211 [6]. | |

Table 9.10.2.5-2: Measurement period for intrafrequency CSI-RS based measurements without gaps(FR2)

|  |  |
| --- | --- |
| DRX cycle | T CSI-RS\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps x Kp\_CSI-RS) x CSI-RS period) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps x Kp\_CSI-RS) x max(CSI-RS period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Mmeas\_period\_w/o\_gaps x DRX cycle x CSSFintra |
| NOTE 1: The requirements apply assuming CSI-RS configuration with {D=3 with PRBs ≥ 48}. D is frequency domain density for the 1-port CSI-RS for L3 mobility defined in clause 7.4.1 of TS38.211 [6]. | |

Mmeas\_period\_w/o\_gaps : For a UE supporting power class 1, Mmeas\_period\_w/o\_gaps =40. For a UE supporting FR2 power class 2, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 3, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps =24.

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1.5.

For a UE not supporting *concurrentMeasGap-r17* or for a UE is supporting *concurrentMeasGap-r17* but not configured with concurrent measurement gaps,

- if the intra-frequency CSI-RS resource does not overlap with any measurement gaps, Kp\_CSI-RS=1;

- if some occaions of the intra-frequency CSI-RS resource is overlap with ameasurement gaps, Kp\_CSI-RS = 1/(1- (CSI-RS resource period /MGRP)) , where CSI-RS resource period < MGRP, and the MGRP is the periodicity of the measurement gap.

- Otherwise, if a UE which support concurrent measurement gaps and has been configured with concurrent measurement gaps, Kp\_CSI-RS is the scaling factor for a CSI-RS frequency layer to be measured outside gap which is defined as Kp\_CSI-RS = Ntotal / Navailable

For a window W of duration max(CSI-RS period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the CSI-RS frequency layer, and starting at the beginning of any gap occasions covering the CSI-RS resources:

Ntotal is the total number of CSI-RS resources within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of CSI-RS resources that are not overlapped with any other non-dropped MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.

Kp\_CSI-RS = 1 when Navailable = 0

Table 9.10.2.5-3: Time period for SFN acquisition for intra-frequency CSI-RS based measurements without gaps(FR1)

|  |  |
| --- | --- |
| DRX cycle | TCSI-RS\_SFN\_intra |
| No DRX | max(200ms, ceil(5 x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(2000ms, ceil (1.5 x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(5 x Kp) 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  NOTE 2: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

#### 9.10.2.6 Scheduling availability of UE during CSI-RS based intra-frequency measurements

UE is required to be capable of measuring without measurement gaps when CSI-RS resources are completely contained in the active BWP of the UE. Note the configured CSI-RS symbol is indicated in *firstOFDMSymbolInTimeDomain* included in *CSI-RS-ResourceConfigMobility* for RRM. When UE is required to perform CSI-RS based RRM measurements, and any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note same numerology for intra-frequency CSI-RS and data of serving cell is considered in this release.

##### 9.10.2.6.1 Scheduling availability of UE performing CSI-RS based measurements in TDD bands

When UE performs CSI-RS intra-frequency measurements in a TDD band,

- UE is not expected to transmit PUCCH/PUSCH/SRS on configured CSI-RS resource symbols, and on 1 OFDM symbol before and after each consecutively configured CSI-RS symbols.

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

##### 9.10.2.6.2 Scheduling availability of UE performing CSI-RS based measurements in FR2

When the UE performs CSI-RS based intra-frequency measurements for L3 mobility management in FR2, the following restrictions apply.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the configured CSI-RS symbol within the configured slot as indicated in *slotConfig* of the corresponding CSI-RS resource to be measured for mobility.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to CSI-RSRP, CSI-RSRQ or CSI-SINR measurement on an FR2 intra-frequency cell in different bands, provided that UE is capable of independent beam management on this FR2 band pair.

### 9.10.3 CSI-RS based Inter-frequency measurements

#### 9.10.3.1 Introduction

A measurement is defined as a CSI-RS based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.10.2.

If a UE is configured with the higher layer parameter *CSI-RS-Resource-Mobility* and the higher layer parameter *associatedSSB* is configured, the UE shall be able to identify inter-frequency cells indicated for measurement and perform CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements of identified inter-frequency cells.

When measurement gaps are needed, the UE is not expected to detect the associated SSB nor perform measurement of the CSI-RS resource configured in *CSI-RS-Resource-Mobility* on an inter-frequency measurement object which start earlier than the gap starting time + switching time, and ends later than the gap end – switching time. When the inter-frequency cells are in FR2 and the per-FR gap is configured to the UE in EN-DC, SA NR, NE-DC and NR-DC, or the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap is configured to the UE in SA NR and NR-DC, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

If a UE is configured with multiple concurrent gaps, the requirements in this clause shall apply when the measurement gap pattern is configured to be associated to the CSI-RS resources of the inter-frequency layer.

#### 9.10.3.2 Requirements applicability

The associated SSB layer of the CSI-RS follows the same requirements as SSB based measurements defined in 9.3.

The requirements in clause 9.10.3 apply, provided:

- The associated SSB of the cell being identified or measured is detectable, and

- All CSI-RS resources on one inter-frequency layer are configured within a window of up to 5ms, and

- The periodicity of the configured CSI-RS resources is 10ms, 20ms or 40ms, and

- CSI-RS resources for measurements and the associated SSB for cell identification are configured within measurement gap.

An inter-frequency cell shall be considered detectable when for each relevant associated SSB:

- SS-RSRP related side conditions given in clauses 10.1.4.1 and 10.1.5.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9.1 and 10.1.10.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14.1 and 10.1.15.1 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

A CSI-RS resource shall be considered measurable when for each relevant CSI-RS resource:

- CSI-RSRP related side conditions given in clauses 10.1.4.3 and 10.1.5.3 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-RSRQ related side conditions given in clauses 10.1.9.2 and 10.1.10.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-SINR related side conditions given in clauses 10.1.14.2 and 10.1.15.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI \_RP and CSI-RS Ês/Iot according to Annex B.2.13 for a corresponding Band.

#### 9.10.3.3 Number of cells and number of CSI-RS resources

##### 9.10.3.3.1 Requirements for FR1

For each inter-frequency CSI-RS layer, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 14 CSI-RSs with different CSI-RS index and/or PCI , and

- The cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer of the associated SSB.

##### 9.10.3.3.2 Requirements for FR2

For each inter-frequency CSI-RS layer, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 24 CSI-RSs with different CSI-RS index and/or PCI, and

- The cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer the associated SSB.

#### 9.10.3.4 Measurements reporting requirements

Note: The UE is not required to report CSI-RS based L3 measurements when the timing offset between the reference measurement timing and the target CSI-RS in one layer is larger than one CP. If the UE reports CSI-RS based L3 measurements when the timing offset exceeds one CP, the UE may not meet the CSI-RS based L3 measurement accuracy requirements for CSI-RSRP, CSI-RSRQ and CSI-SINR in TS 38.133 section 10.1, which apply only when the timing offset is no larger than one CP.

##### 9.10.3.4.1 Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.2, 10.1.5.2, 10.1.9.2, 10.1.10.2, 10.1.14.2 and 10.1.15.2..

##### 9.10.3.4.2 Event-triggered Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.2, 10.1.5.2, 10.1.9.2, 10.1.10.2, 10.1.14.2 and 10.1.15.2..

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.10.3.4.3.

##### 9.10.3.4.3 Event-triggered Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.2, 10.1.5.2, 10.1.9.2, 10.1.10.2, 10.1.14.2 and 10.1.15.2..

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within CSI-RS based measurement defined in clause .When L3 filtering is used an additional delay can be expected.

#### 9.10.3.5 Inter frequency measurements with measurement gaps

When measurement gaps are provided, if configured with the higher layer parameters *CSI-RS-Resource-Mobility* and *associatedSSB,* the UE shall be able to identify a new detectable CSI-RS based inter frequency cell within T CSI-RS\_identify\_inter,

T CSI-RS\_identify\_inter = (TPSS/SSS\_sync + T CSI-RS\_measurement\_period\_inter + TCSI-RS\_SFN\_inter) ms

Where:

TPSS/SSS\_sync is the time period used in PSS/SSS detection which is determined according to TPSS/SSS\_sync\_inter in clause9.3.4,

TCSI-RS\_SFN\_inter is the time period used to acquire the SFN information of the cell being measured, which is shown in Table 9.10.3.5-3 for FR1 and equals inter-frequency TSSB\_time\_index\_inter in Clause 9.3.4 for FR2,

TCSI-RS\_measurement\_period\_inter: equal to a measurement period of CSI-RS based measurement given in table 9.10.3.5-1 and table 9.10.3.5-2..

Mmeas\_period\_inter: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter =8×N samples. For a UE supporting FR2 power class 2, Mmeas\_period\_inter=5×N samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter =5×N samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter = 5×N samples. Note that scaling factor N = [8].

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5 for measurement conducted within measurement gaps.

If a UE which supports concurrent measurement gaps has been configured with concurrent measurement gaps, Kp\_CSI-RS is the scaling factor for a CSI-RS frequency layer to be measured within the associated measurement gap which is defined as Kp\_CSI-RS = Ntotal / Navailable. Kp\_CSI-RS = 1 for for UE not configured with concurrent measurement gaps.

- For a window W of duration max(CSI-RS period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the CSI-RS frequency layer, and starting at the beginning of any gap occasions covering the CSI-RS resources.:

- Ntotal is the total number of associated gap occasions covering CSI-RS resources within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

- Navailable is the number of non-dropped associated gap occasions covering CSI-RS resources within the window W, after accounting for MG collisions by applying the selected gap collision rule.

- Requirements do not apply if Navailable = 0

Additionally, for a given CSI-RS resource, if the associated SSB is configured but not detected by the UE, or if CSI-RS configured with associated SSB but not QCL-ed to the associated SSB, the UE is not required to monitor the corresponding CSI-RS resource.

Table 9.10.3.5-1: Measurement period for CSI-RS based inter-frequency measurements with gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T CSI-RS\_measurement\_period\_inter |
| No DRX | Max(200ms, ceil(8 × Kp\_CSI-RS) × Max(MGRP, CSI-RS period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5 × Kp\_CSI-RS)) × Max(MGRP, CSI-RS period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 × Kp\_CSI-RS) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: If UE support concurrent gaps and multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the CSI-RS resources of the inter-frequency layer.  NOTE 4: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

Table 9.10.3.5-2: Measurement period for CSI-RS based inter-frequency measurements with gaps (FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T CSI-RS\_measurement\_period\_inter |
| No DRX | Max(400 ms, ceil( Mmeas\_period\_inter × Kp\_CSI-RS )× Max(MGRP, CSI-RS period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400 ms, ceil(1.5 × Mmeas\_period\_inter× Kp\_CSI-RS) × Max(MGRP, CSI-RS period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Mmeas\_period\_inter × Kp\_CSI-RS )× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: If UE support concurrent gaps and multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the CSI-RS resources of the inter-frequency layer.  NOTE 4: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

Table 9.10.3.5-3: Time period for SFN acuisition for interfrequency CSI-RS based measurements with gaps(FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T CSI-RS\_SFN\_inter |
| No DRX | Max(200ms, ceil(5 × Kp\_CSI-RS )× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(5 × 1.5 × Kp\_CSI-RS) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(5 × Kp\_CSI-RS )× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: If UE support concurrent gaps and multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to *associatedSSB*.  NOTE 4: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

## 9.11 NR measurements with autonomous gaps

### 9.11.1 Introduction

The requirements in this clause are applicable for CGI identification of an intra frequency and inter frequency NR target cell.

The requirements in this clause are specified for CGI identification of an NR target cell and are applicable for a UE:

- in RRC\_CONNECTED state, and

- configured with SA or NR-DC or NE-DC operation mode, or with EN-DC operation mode for CGI identification requested by NR PSCell.

The overall CGI reporting delay is defined in clause 9.11.3.

### 9.11.2 CGI identification of an NR cell with autonomous gaps

The UE shall identify and report the CGI of a known NR target cell when requested by the network for the purpose of reportCGI. Only one cell is provided to the UE with *cellForWhichToReportCGI* for identifying the CGI.The UE may make autonomous gaps in both downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3 of TS 38.331 [2]. Note that a UE is not required to use autonomous gap if *useAutonomousGaps* is set to false. If autonomous gaps are used for measurement with the purpose of reportCGI, regardless of whether DRX is used or not, or whether SCell(s) are configured or not, the UE shall be able to identify a new CGI of NR cell within:

Tidentify\_CGI = (TMIB + T SIB1) ms

Where:

TMIB is the time period used to acquire MIB message. TMIB = 6 \* TSMTC ms for target cell carrier frequency on FR1 and TMIB = 25 \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1 is the time period used to acquire SIB1 message. TSIB1 = 6 \* TRMSI-scheduling ms.

Where TSMTC is the SMTC periodicity configured for the target cell measurement, and TRMSI-scheduling is

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and 20ms when SSB and RMSI CORESET multiplexing pattern is 1

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and TSMTC when SSB and RMSI CORESET multiplexing pattern is 2 or 3.

The requirement for identifying the CGI of an NR cell within Tidentify\_CGI is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

Within the time Tidentify\_CGI, over which the UE identifies the CGI of an NR cell, the UE shall fulfil interruption requirements specified in,

- Clause 8.2.1.2.16 for NR serving cells and Clause 7.32.2.15 in TS36.133 [15] for E-UTRA serving cells if the UE is configured with EN-DC operation mode,

- Clause 8.2.2.2.14 if the UE is configured with SA operation mode,

- Clause 8.2.3.2.14 for NR serving cells and Clause 7.36.2.14 in TS36.133 [15] for E-UTRA serving cells if the UE is configured with NE-DC operation mode,

- Clause 8.2.4.2.11 if the UE is configured with NR-DC operation mode.

In the requirement a cell is known if,

- During the last 5 seconds for FR1 or 3 seconds for FR2 before the reception of the report CGI command:

- The UE has sent a valid L3-RSRP measurement report with SSB index for the target cell and

- During MIB decoding at least reported SSBs remains detectable according to the cell identification conditions specified in clauses 9.2 or 9.3 of TS 38.133, and

- During SIB1 decoding the SSB used for MIB decoding remains detectable according to the cell identification conditions specified in clauses 9.2 or 9.3 of TS 38.133, and

- During MIB decoding, the SSB for MIB decoding remains detectable with SNR ≥-3dB

- During SIB1 decoding, the PDSCH for SIB1 decoding remains detectable with SNR ≥-3dB

### 9.11.3 CGI reporting delay

The CGI reporting delay is defined as the time between a command that will trigger a CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than Tidentify\_CGI defined in clause 9.11.2 plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and additional 20ms margin if target cell is on FR2.

## 9.11A NR measurements with autonomous gaps for RedCap

### 9.11A.1 Introduction

The requirements in this clause are applicable for CGI identification of an intra frequency and inter frequency NR target cell.

The requirements in this clause are specified for CGI identification of an NR target cell and are applicable for a UE:

- in RRC\_CONNECTED state, and

- configured with SA operation mode.

The overall CGI reporting delay is defined in clause 9.11A.3.

### 9.11A.2 CGI identification of an NR cell with autonomous gaps

The UE shall identify and report the CGI of a known NR target cell when requested by the network for the purpose of reportCGI. Only one cell is provided to the UE with *cellForWhichToReportCGI* for identifying the CGI.The UE may make autonomous gaps in both downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3 of TS 38.331 [2]. Note that a UE is not required to use autonomous gap if *useAutonomousGaps* is set to false. If autonomous gaps are used for measurement with the purpose of reportCGI, regardless of whether DRX is used or not, the UE shall be able to identify a new CGI of NR cell within:

Tidentify\_CGI\_redcap = (TMIB\_redcap + T SIB1\_redcap) ms

Where:

For 2 Rx RedCap UE:

TMIB\_redcap is the time period used to acquire MIB message. TMIB\_redcap = 6 \* TSMTC ms for target cell carrier frequency on FR1 and TMIB\_redcap = 25 \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1\_redcap is the time period used to acquire SIB1 message. TSIB1\_redcap = 6 \* TRMSI-scheduling ms.

For 1 Rx RedCap UE:

TMIB\_redcap is the time period used to acquire MIB message. TMIB\_redcap = 6 \* TSMTC ms for target cell carrier frequency on FR1 and TMIB\_redcap = 25 \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1\_redcap is the time period used to acquire SIB1 message. TSIB1\_redcap = 12 \* TRMSI-scheduling ms.

Where TSMTC is the SMTC periodicity configured for the target cell measurement, and TRMSI-scheduling is

- the periodicity with which the SIB1 is actually transmitted by the NR target cell when SSB and RMSI CORESET multiplexing pattern is 1

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and TSMTC when SSB and RMSI CORESET multiplexing pattern is 2 or 3.

The requirement for identifying the CGI of an NR cell within Tidentify\_CGI\_redcap is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

Within the time Tidentify\_CGI\_redcap, over which the UE identifies the CGI of an NR cell, the UE shall fulfil interruption requirements specified in,

- Clause [8.2.2.2.14] if the UE is configured with SA operation mode.

In the requirement a cell is known if,

- During the last 5 seconds for FR1 or 3 seconds for FR2 before the reception of the report CGI command:

- The UE has sent a valid L3-RSRP measurement report with SSB index for the target cell and

- During MIB decoding at least reported SSBs remains detectable according to the cell identification conditions specified in clauses 9.2B or 9.3B of TS 38.133, and

- During SIB1 decoding the SSB used for MIB decoding remains detectable according to the cell identification conditions specified in clauses 9.2B or 9.3B of TS 38.133, and

- During MIB decoding, the SSB for MIB decoding remains detectable with SNR ≥-3dB

- During SIB1 decoding, the PDSCH for SIB1 decoding remains detectable with SNR ≥-3dB

### 9.11A.3 CGI reporting delay

The CGI reporting delay is defined as the time between a command that will trigger a CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than Tidentify\_CGI\_redcap defined in clause 9.11A.2 plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and additional 20ms margin if target cell is on FR2.

### 9.11A.4 CGI reporting scheduling restriction

When a RedCap UE is identifying CGI of an NR cell with autonomous gaps, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on PCell for the following slots:

- with up to K1 interruptions with interrupted slots up to X1 specified in Table 9.11A.4-1 for each interruption during MIB decoding time period TMIB\_redcap (ms) specified in clause 9.11A.2.

- with up to L1 interruptions with interrupted slots up to Y1 specified in Table 9.11A.4-1 during SIB1 decoding time period TSIB1\_redcap (ms) specified in clause 9.11A.2 for SSB and CORESET for RMSI scheduling multiplexing patterns 1.

- with up to L2 interruptions with interrupted slots up to interruption length Y2 specified in Table 9.11A.4-1 during SIB1 decoding time period TSIB1\_redcap (ms) specified in clause 9.11A.2 for SSB and CORESET for RMSI scheduling multiplexing patterns 2 and 3.

Where:

- K1 = 6 for the target cell carrier frequency on FR1 and K1 = 25 for the target cell carrier frequency on FR2, and

- L1 = TSIB1\_redcap /20 and

- L2 = TSIB1\_redcap /TSMTC, where TSMTC is the periodicity of the SMTC occasion configured for the target cell carrier.

Table 9.11A.4-1: Interruption length X1, Y1 and Y2 during measurements with autonomous gaps

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | Interruption length Y1 (slots) | Interruption length Y2 (slots) |
| 0 | 1 | 6 | 7 | 6 |
| 1 | 0.5 | 12 | 13 | 10 |
| 2 | 0.25 | 24 | 25 | 19 |
| 3 | 0.125 | 48 | 49 | 37 |

## 9.12 Measurement for Propagation Delay Compensation

### 9.12.1 Introduction

The requirements in this clause are applicable for UE capable of RTT-based propagation delay compensation based on PRS/TRS and SRS, where the UE is configured with *measObjectRxTxDiff* in *MeasObjectToAddModList* defined in TS38.331 [2].

### 9.12.2 Requirements Applicability

The requirements in clause 9.12 apply for periodic triggered UE Rx-Tx time difference measurements, provided:

- If UE Rx-Tx time difference measurement is based on PRS, the related side conditions given in clause 10.1.39.2 are met for a corresponding band.

- If UE Rx-Tx time difference measurement is based on TRS, the related side conditions given in clause 10.1.39.3 are met for a corresponding band.

- SRS is configured on at least one of the PCell.

All measurement requirements specified in clause 9.12.4 shall apply when no DRX is in use as well as for when DRX is in use (clause 3.6.1) for any DRX configuration specified in TS 38.331 [2].

### 9.12.3 Measurement Capability

If UE Rx-Tx time difference measurement is based on PRS, the capability is as indicated by the UE in *rtt-BasedPDC-PRS-r17* in TS38.331 [2].

If UE Rx-Tx time difference measurement is based on TRS, the capability is as indicated by the UE in *rtt-BasedPDC-CSI-RS-ForTracking-r17* in TS38.331 [2].

### 9.12.4 Measurement period requirements

#### 9.12.4.1 PRS Measurement Period

When UE is configured with *prs-Ref-r17* in *MeasObjectRxTxDiff*-r17 defined in TS 38.331 [2] and provided with PRS resource configuration, the UE shall be able to measure UE Rx-Tx time difference on PCell within the measurement period TUERx-Tx\_PRS, where:

Where:

is the maximum number of DL PRS resources configured in a slot,

is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumberPRS-ResourceProcessedPerSlot-r17* as specified in TS38.331 [2],

is the number of UE Rx-Tx time difference measurement samples and = 4,

is the PRS resource periodicity specific for RTT-based propagation delay compensation,

is the DRX cycle length when DRX is in use, 1ms otherwise.

is

Ntotal / Navailable, when Navailable>0

Where,

- For a window W of duration LCM(TPRS, MGRP\_max, TSMTC) and starting at the beginning of any PRS resource occasion, where TSMTC is the periodicity of SMTC for intra-frequency measurement without gap and MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as PCell for a UE that support *concurrentMeasGap-r17* and is configured with concurrent measurement gaps, otherwise MGRP max is the MGRP of configured per-UE measurement gap or per-FR measurement gap within the same FR as PCell:

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

- Navailable is the number of PRS resource occasions that are not overlapped with:

- For FR1: any measurement gap occasions within window W. And for a UE supporting *concurrentMeasGap-r17* after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3 within the window W

- For FR2: any measurement gap occasions nor any SMTC occasions within window W. And for a UE supporting *concurrentMeasGap-r17* after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3 nor any SMTC occasions within the window W.

No requirements shall apply if Navailable=0.

UE is only required to perform UE Rx-Tx time difference on PRS within the active DL BWP.

When UE is configured to perform UE Rx-Tx time difference measurement based on PRS, the requirements apply provided that the SCS of the PRS is same as that of the active BWP on PCell.

For FR2, the requirements apply if QCL information is provided for all the PRS resources in the resource set and for each resource one RS has QCL-TypeD.

If PRS resources overlap with Type 1A/1B/2 PPW, the UE is allowed longer measurement period to measure UE Rx-Tx time difference on PCell.

#### 9.12.4.2 TRS Measurement Period

When UE is configured with *csi-RS-Ref-r17* in *MeasObjectRxTxDiff*-r17 defined in TS 38.331 [2] and provided with TRS resource configuration, the UE shall be able to measure UE Rx-Tx time difference on PCell within the measurement period TUERx-Tx\_TRS, where:

Where

is the number of UE Rx-Tx time difference measurement samples and is [4],

is the TRS resource periodicity specific for RTT-based propagation delay compensation,

is the DRX cycle length when DRX is in use, 1ms otherwise.

is

Ntotal / Navailable when Navailable>0

Where,

- For a window W of duration LCM(TTRS, MGRP\_max, TSMTC) and starting at the beginning of any TRS resource occasion, where TSMTC is the periodicity of SMTC for intra-frequency measurement without gap and MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as PCell for a UE that support *concurrentMeasGap-r17* and is configured with concurrent measurement gaps, otherwise MGRP\_max is the MGRP of configured per-UE measurement gap or per-FR measurement gap within the same FR as PCell:

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

- Navailable is the number of TRS resource occasions that are not overlapped with

- For FR1: any measurement gap occasions within window W. And for a UE supporting *concurrentMeasGap-r17* after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3 within the window W

- For FR2: any measurement gap occasions nor any SMTC occasions within window W. And for a UE supporting *concurrentMeasGap-r17* after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3 nor any SMTC occasions within the window W.

No requirements shall apply if Navailable=0.

UE is only required to perform UE Rx-Tx time difference on TRS within the active DL BWP. When UE is configured to perform UE Rx-Tx time difference measurement based on TRS, the requirements apply provided that the SCS of the TRS is same as that of the active BWP on PCell.

For FR2, the requirements apply if QCL information is provided for all the TRS resources in the resource set and for each resource one RS has QCL-TypeD.

If TRS resources overlap with Type 1A/1B/2 PPW, the UE is allowed longer measurement period to measure UE Rx-Tx time difference on PCell.

### 9.12.5 Measurement Reporting Requirements

The UE shall report UE Rx-Tx time difference measurement results if UE supports *gNB-SideRTT-BasedPDC-r17*.

The measurement reporting delay excludes the delay uncertainty caused by inserting the measurement report into the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The UE Rx-Tx time difference measurement values contained in measurement report shall be based on the measurement report mapping requirements specified in clause 10.1.25.3, with k = 5.

The UE Rx-Tx time difference measurement accuracy shall be fulfilled according to the accuracy requirements specified in clause 10.1.39.2 and 10.1.39.3 for PRS and TRS, respectively.

### 9.12.6 Scheduling availability during measurement for Propagation Delay Compensation

During measurement for Propagation Delay Compensation in an FR2 cell,

- For the case where the PRS or TRS for PDC measurement is QCLed with active TCI state for PDCCH/PDSCH, there are no scheduling restrictions due to PDC measurement performed based on PRS or TRS.

- Otherwise, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the PRS or TRS resource configured for PDC measurement.

### 9.12.7 Measurement restriction for measurement for Propagation Delay Compensation

During measurement for Propagation Delay Compensation in an FR2 cell, when the PRS or TRS for PDC measurement on one CC is in the same OFDM symbol as SSB or CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both PRS or TRS for PDC measurement and the other RS if they are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE. Longer measurement period for PRS or TRS for PDC measurement is expected.

## 9.13 L1-RSRP measurements for a cell with different PCI from serving cell

### 9.13.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured measurement resources from a cell with different PCI in addition to serving cell (PCI indicated in *additionalPCI-r17*), with the measurement resources configured as SSBs of the cell with different PCI.

The UE shall be able to measure all SSB resources of the cell with different PCI in *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings for the active BWP, while the *additionalPCI-r17* of the SSB resources are different from serving cell PCI. The number of resources, including the number of resources configured for serving cell L1-RSRP measurement in 9.5, does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the higher layer parameter *reportConfigType* of each reporting setting *CSI-ReportConfig* for the active BWP.

### 9.13.2 Requirements Applicability

The requirements in the clause 9.13 are applicable to inter-cell beam management and inter-cell multi-TRP scenarios.

The requirements in clause 9.13 apply, provided the SSB from cell with PCI different from serving cell configured for L1-RSRP if the following conditions are met:

- the number of cells with PCI different from seving cells Nmax = 1 for FR2 and Nmax = maxNrofAdditionalPCI for FR1. Where, maxNrofAdditionalPCI is defined in TS 38.331 [2].

- The SSB from the cell with different PCI completely contained in the active BWP or associated with initial downlink BWP of the UE

- The SSB of the cell with different PCI from serving cell has the same SCS, SFN offset and center frequency as the SSB of the serving cell

- The timing difference of arrival at UE between the SSBs of serving cell and cell with different PCI is less than CP length of the corresponding SCS

- The cell with different PCI from serving cell is known

- The SSB resources configured for L1-RSRP measurements are measurable

An SSB resource configured for L1-RSRP for cell with different PCI from serving cell shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

The cell with different PCI from serving cell is considered as known if the following conditions are met in this requirement:

- The UE has sent a valid L3 measurement report during the last 5 seconds, and

- The SSB from the cell with different PCI remains detectable according to the cell identification requirements specified in clause 9.2.

Otherwise, the cell is unknown.

### 9.13.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting-r17* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

#### 9.13.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.13.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.13.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement report if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.13.4 L1-RSRP measurement requirements

#### 9.13.4.1 Inter-cell SSB based L1-RSRP Reporting

If a cell with PCI different from serving cell is known according 9.13.2, 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\_CDP. The requirements specified in this clause are only applicable when

- *highSpeedMeasFlag-r16* is not configured, and

- *highSpeedMeasFlagFR2-r17* is not configured, and

- highSpeedMeasCA-Scell-r17 is not configured, and

- SSBs of CDP outside SMTCs for L1-RSRP measurement are not overlapped with concurrent gaps.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_CDP is defined in Table 9.13.4.1-1 for FR1, The value of TL1-RSRP\_Measurement\_Period\_SSB\_CDP is defined in Table 9.13.4.1-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, where

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

- N= 8.

For FR1,

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

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

For FR2,

- P is PL1\_sharing\*Psharing factor, CDP, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB\_CDP = TSMTCperiod), and TSSB\_SC = TSMTCperiod.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP), and TSSB\_SC = TSMTCperiod.

- P2=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod).

- P2=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB\_CDP < 0.5\*TSMTCperiod

- P2= ,when SSB is partially overlapped with measurement gap (TSSB\_CDP <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- If SSB resource from serving cell is configured for L1-RSRP measurements, and P1 is valid accoding to 9.5.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain)

- P = , if P2\*TSSB\_CDP < P1\*TSSB\_SC.

- P = P2, if P2\*TSSB\_CDP> P1\*TSSB\_SC.

- P = 2\*P2, if P1\*TSSB\_SC = P2\*TSSB\_CDP.

- Otherwise, P = P2

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

- TSMTCperiod = the configured SMTC period

- TSSB\_SC = ssb-periodicityServingCell of the serving cell

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

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

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

- Psharing factor = 3, otherwise.

- PL1\_sharing = 2, if SSB resource from serving cell is configured for L1-RSRP measurements, and Psharing\_factor is used in 9.5.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain). PL1\_sharing = 1, otherwise.

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

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

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

For either an FR1 or FR2 cell with PCI different from serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.13.4.1-1: Inter-cell L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CDP for known cells with different PCIs in FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CDP (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB\_CDP) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB\_CDP)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB\_CDP is the periodicity of the SSB-Index configured for inter-cell L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1.5. | |

Table 9.13.4.1-2: Inter-cell L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CDP for known cells with different PCIs in FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CDP (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB\_CDP) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB\_CDP)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB\_CDP is the periodicity of the SSB-Index configured for inter-cell L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

### 9.13.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB for L1-RSRP without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

Unless explicitly stated, the SSB to be measured for L1-RSRP measurement is transmitted from cell(s) with PCI different from serving cell(s).

#### 9.13.5.1 Measurement restriction for SSB based L1-RSRP

For FR1,

when the SSB for L1-RSRP measurement is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

when the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2,

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both the two SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB for L1-RSRP measurement on the different CCs in the same band, UE is required to measure one of but not both the two SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

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

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

### 9.13.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions described in the following clauses apply when UE is performing L1-RSRP measurement on cell(s) with PCI different from serving cell, and UE is receiving PDCCH/PDSCH from serving cell and/or cell(s) with different PCI.

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

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

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

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

- 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.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions apply to cell(s) in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 cells configured in other bands than the bands in which the cell where L1-RSRP measurement is performed is configured.

#### 9.13.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to 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.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions is performed apply to cell(s) in the band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 cells in the bands due to L1-RSRP measurement performed on FR2 cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

If following conditions are met,

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

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

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.13.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 cell(s) due to L1-RSRP measurement performed on FR2 cell(s).

There are no scheduling restrictions on FR2 cell(s) due to L1-RSRP measurement performed on FR1 cell(s).

#### 9.13.6.5 Scheduling availability of UE performing L1-RSRP measurement in TDD bands on FR1

When UE performs L1-RSRP measurement on cell with different PCI from serving cell in a TDD band, the following restrictions apply due to L1-RSRP measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on symbols corresponding to the SSB indexes configured for L1-RSRP measurement, where the transmission of PUCCH/PUSCH/SRS may be on serving cell(s) and cell(s) with PCI different from serving cell(s), and restricted symbols may partially or fully overlap with UL symbols