**3GPP TSG-RAN4 Meeting #104-e *R4-221xxxx***

**Electronic Meeting, 15 – 26 August, 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **2534** | **rev** | **1** | **Current version:** | **17.6.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | CR on intra-frequency measurement requirements for NTN |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_NTN\_solutions-Core |  | ***Date:*** | 2022-07-19 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | 1. Definition of kmulti-SMTC (scaling factor for overlapping SMTC and multiple LEO satellites) is missing for intra-frequency measurement outside MG.
2. As agreed in RAN4#103-e (Issue 3-1-4A), scaling factor Klayer1 should be added to intra-frequency measurement outside MG.
3. Scaling factor kmulti-SMTC should be also added to intra-frequency measurement with MG, similar as for inter-frequency measurement.
4. The requirement applicability related to scheduling restriction overhead, as agreed in R4-2210610 has not been captured in spec.
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|  |  |
| ***Summary of change:*** | 1. Add definition of kmulti-SMTC based on agreement in RAN4#103-e (Issue 3-1-4B) for intra-frequency measurement outside MG.
2. Add scaling factor Klayer1 for intra-frequency measurement outside MG, by re-using the Klayer1 for FR2 TN.
3. Add scaling factor kmulti-SMTC for intra-frequency measurement with MG.
4. Capture the requirement applicability related to scheduling restriction overhead, as agreed in R4-2210610 in spec.
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| ***Consequences if not approved:*** | NTN Intra-frequency measurement requirements are incomplete. |
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| ***Clauses affected:*** | 9.2C.5, 9.2C.6 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Start of Change 1>

### 9.2C.5 Intrafrequency measurements without measurement gaps

#### 9.2C.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.

 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*.

 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.*

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.*

### 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 the scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern, and Kgap = TBD

 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 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.

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 |

<End of Change 1>