**3GPP TSG-RAN4 Meeting #109  *R4-2321638***

Chicago, US, November 13th – 17th, 2023

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  |  | **CR** | **7275** | **rev** | **1** | **Current version:** | **18.3.1** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Big CR to TS 36.133 on inter-RAT NR measurement without gap |
|  |  |
| ***Source to WG:*** | MediaTek inc., Intel Corporation |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_MG\_enh2-Core |  | ***Date:*** | 03 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | Introduce core requirements for NR\_MG\_enh2-Core |
|  |  |
| ***Summary of change:*** | The changes are:Change 1 includes endorsed draft CR R4-2321568:* Interruprion requirements for inter-RAT NR measurement without gap (case a-1).

Change 2 includes endorsed draft CR R4-2321569:* Measurement period and scheduling restriction for inter-RAT NR measurement without gap.
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| ***Consequences if not approved:*** | There will be incomplete further enhancement on measurement gaps specifications in TS 36.133.  |
|  |  |
| ***Clauses affected:*** | New caluses: 7.8.2.x, 8.1.2.4.z1, 8.1.2.4.z2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.533 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**----------------------START OF CHANGE 1----------------------------**

#### 7.8.2.x Interruptions during inter-RAT NR measurements without measurement gap

For a UE indicating ‘no-gap-with-interruption’ with the capability [*interRAT-NeedForIntrNR-r18*] for inter-RAT NR measurement, the UE is allowed to cause interruptions on PCell or activated SCell(s) due to inter-RAT NR measurements with interruption ratio no more than the requirements specified below.

For the individual inter-RAT NR measurements performed on a frequency layer that corresponds to a configured measurement object i, Tcycle,i is the measurement cycle specified in Table 7.8.2.x-1, where Nfreq is defined in clause 8.1.2.4.z1.1.1.

Table 8.2.2.2.X-1: Tcycle,i length for inter-RAT NR MOi

|  |  |
| --- | --- |
| DRX cycle | TCycle,I |
| No DRX | max (80ms, SMTC period) x Nfreq |
| [DRX cycle ≤ 320ms] | FFS |
| [DRX cycle>320ms] | FFS |

*Editors’ note: Discussion is ongoing on cases where DRX is configured. Further update to this sub-clause subjects to the conclusions of the discussion.*

UE is allowed to cause interruption on a certain MOi up to the interruption ratio of . The allowed maximum total interruption ratio (D) is

Where,

* N is the total number of NR MOs that UE indicates [nogap-interruption] for the band which the NR MO belongs to, and none of the SMTCs of the NR MOs are overlapped by the measurement gap, and
* L is the maximum interruption length for each interruption occasion, which shall not exceed 1 subframe.

The interruptions are allowed for all the serving cells in the same FR as NR SCell being measured if UE supports per-FR measurement gaps, and all the serving cells if UE does not support per-FR measurement gaps.

**----------------------END OF CHANGES 1----------------------------**

**----------------------START OF CHANGE 2----------------------------**

##### 8.1.2.4.z1 E-UTRAN FDD – NR measurements without measurement gap

Requirements in this clause shall apply for UE capable of performing inter-RAT NR measurement without measurement gap as indicated via *interRAT-NeedForIntrNR*, when UE is not configured with EN-DC.

When measurement gap is configured, and the NR measurement object satisfies one the following conditions, requirements in clause 8.1.2.4.21 apply.

 UE indicates *[nogap-interruption]* for the band which the NR measurement object belongs to, and some or all of the SMTCs of the NR measurement object are overlapped by the measurement gap,

 UE indicates *[nogap-nointerruption]* for the band which the NR measurement object belongs to, and all of the SMTCs of the NR measurement object are overlapped by the measurement gap.

When measurement gap is configured, and the NR measurement object satisfies one the following conditions, requirements in clause 8.1.2.4.z1.1 apply.

 UE indicates *[nogap-interruption]* for the band which the NR measurement object belongs to, and none of the SMTCs of the NR measurement object is overlapped by the measurement gap,

 UE indicates *[nogap-nointerruption]* for the band which the NR measurement object belongs to, and part or none of the SMTCs of the NR measurement object are overlapped by the measurement gap.

When measurement gap is not configured, requirements in clause 8.1.2.4.z1.1 apply.

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

8.1.2.4.z1.1.1 Identification of a new NR cell

UE shall be able to identify a new detectable cell within Tidentify\_irat\_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-RAT cell within Tidentify\_irat\_with\_index. The UE shall be able to identify a new detectable inter-RAT SS block of an already detected cell within Tidentify\_irat\_without\_index.

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

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

Where:

 TPSS/SSS\_sync\_irat: it is the time period used in PSS/SSS detection given in table 8.1.2.4.z1.1.1-1, 8.1.2.4.z1.1.1-1A and table 8.1.2.4.z1.1.1-2.

 TSSB\_time\_index\_irat: it is the time period used to acquire the index of the SSB being measured given in table 8.1.2.4.z1.1.1-3, 8.1.2.4.z1.1.1-3A and table 8.1.2.4.z1.1.1-4.

 TSSB\_measurement\_period\_irat: equal to a measurement period of SSB based measurement given in table 8.1.2.4.z1.1.1-5, 8.1.2.4.z1.1.1-5A and table 8.1.2.4.z1.1.1-6.

Mpss/sss\_sync\_irat: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_irat = 64 samples. For a UE supporting FR2 power class 2 (vehicle mounted), Mpss/sss\_sync\_irat = 40 samples. For a UE supporting FR2 power class 3 (handheld), Mpss/sss\_sync\_irat = 40 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_irat = 40 samples.

MSSB\_index\_irat: For a UE supporting FR2 power class 1 or 5, MSSB\_index\_irat = 40 samples. For a UE supporting FR2 power class 2 (vehicle mounted), MSSB\_index\_irat = 24 samples. For a UE supporting FR2 power class 3 (handheld), MSSB\_index\_irat = 24 samples. For a UE supporting FR2 power class 4, MSSB\_index\_irat = 24 samples.

Mmeas\_period\_irat: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_irat = 64 samples. For a UE supporting FR2 power class 2 (vehicle mounted), Mmeas\_period\_irat = 40 samples. For a UE supporting FR2 power class 3 (handheld), Mmeas\_period\_irat = 40 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_irat = 40 samples.

TLB: TLB = 0 if UE indicates [*nogap-nointerruption*] for the band which the NR measurement object belongs to, and TLB = 80ms if UE indicates [*nogap-interruption*] for the band which the NR measurement object belongs to.

[Nfreq is defined as follows.

 When measurement gap is configured, Nfreq equals to the total number NR measurement objects that satisfy one the following conditions.

 UE indicates *[nogap-interruption]* for the band which the NR measurement object belongs to, and none of the SMTCs of the NR measurement object is overlapped by the measurement gap,

 UE indicates *[nogap-nointerruption]* for the band which the NR measurement object belongs to, and part or none of the SMTCs of the NR measurement object are overlapped by the measurement gap.

 When measurement gap is not configured, Nfreq equals to the total number NR measurement objects that satisfy one the following conditions.

 UE indicates *[nogap-interruption]* for the band which the NR measurement object belongs to,

 UE indicates [nogap-nointerruption] for the band which the NR measurement object belongs to.]

*Editor’s note: Nfreq may be updated based on further discussion.*

Kp is a scaling factor calculated as follows:

 When the SMTC of the inter-RAT NR carrier is fully non-overlapping with measurement gaps, Kp =1;

 When the SMTC of the inter-RAT NR carrier is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP.

Table 8.1.2.4.z1.1.1-1: Time period for PSS/SSS detection (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1 | TPSS/SSS\_sync\_irat |
| No DRX | max(600ms, ceil(8 × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle ≤ 320ms | max(600ms, ceil(8 × Kp × 1.5) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | ceil(8 × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

Table 8.1.2.4.z1.1.1-1A: Time period for PSS/SSS detection for UE configured with *highSpeedInterRAT-r16* (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_irat |
| No DRX | max(600ms, ceil(8 × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle < 320ms | max(600ms, ceil(8 × Kp × M) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle ≥ 320ms | ceil(8 × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5.NOTE 2: M = 1 when SMTC < = 40ms, and M = 1.5 when SMTC > 40ms |

Table 8.1.2.4.z1.1.1-2: Time period for PSS/SSS detection (Frequency range FR2)

|  |  |
| --- | --- |
| Condition NOTE1 | TPSS/SSS\_sync\_irat |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_irat × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle ≤ 320ms | max(600ms, ceil(Mpss/sss\_sync\_irat × Kp × 1.5) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | ceil(Mpss/sss\_sync\_irat × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

Table 8.1.2.4.z1.1.1-3: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1 | TSSB\_time\_index\_irat |
| No DRX | max(120ms, ceil(3 × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle ≤ 320ms | max(120ms, ceil(3 × Kp × 1.5) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | ceil(3 × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

Table 8.1.2.4.z1.1.1-3A: Time period for time index detection for UE configured with *highSpeedInterRAT-r16* (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TSSB\_time\_index\_irat |
| No DRX | max(120ms, ceil(3 × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle < 320ms | max(120ms, ceil(3 × Kp × M) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle ≥ 320ms | ceil(3 × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5.NOTE 2: M = 1 when SMTC < = 40ms, and M = 1.5 when SMTC > 40ms |

Table 8.1.2.4.z1.1.1-4: Time period for time index detection (Frequency range FR2)

|  |  |
| --- | --- |
| Condition NOTE1 | TSSB\_time\_index\_irat |
| No DRX | max(200ms, ceil(MSSB\_index\_irat × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle ≤ 320ms | max(200ms, ceil(MSSB\_index\_irat × Kp × 1.5) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | ceil(MSSB\_index\_irat × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

In the requirements, an NR cell is considered detectable when:

- NR SS-RSRP related conditions in the accuracy requirements in Section 9.11.1 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 of TS 38.133 [50],

- NR SS-RSRQ related conditions in the accuracy requirements in Section 9.11.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 of TS 38.133 [50],

- NR SS-SINR related conditions in the accuracy requirements in Section 9.11.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 of TS 38.133 [50].

UE physical layer shall be capable of reporting NR SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clause 9.11, with measurement period as shown in table 8.1.2.4.z1.1.1-5, 8.1.2.4.z1.1.1-5A and 8.1.2.4.z1.1.1-6:

Table 8.1.2.4.z1.1.1-5: Measurement period for inter-RAT measurements (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1 | TSSB\_measurement\_period\_irat |
| No DRX | max(200ms, ceil(8 × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle ≤ 320ms | max(200ms, ceil(8 × Kp × 1.5) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | ceil(8 × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

Table 8.1.2.4.z1.1.1-5A: Measurement period for inter-RAT measurements for UE configured with *highSpeedInterRAT-r16* (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TSSB\_measurement\_period\_irat |
| No DRX | max(200ms, ceil(8 × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle < 320ms | max(200ms, ceil(8 × Kp × M) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle ≥ 320ms | ceil(4 × Kp × M) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5.NOTE 2: M = 1 when SMTC < = 40ms, and M = 1.5 when SMTC > 40ms |

Table 8.1.2.4.z1.1.1-6: Measurement period for inter-RAT measurements (Frequency range FR2)

|  |  |
| --- | --- |
| Condition NOTE1 | TSSB\_measurement\_period\_irat |
| No DRX | max(400ms, ceil(Mmeas\_period\_irat × Kp) × max(TLB, SMTC period)) × Nfreq |
| DRX cycle ≤ 320ms | max(400ms, ceil(Mmeas\_period\_irat × Kp × 1.5) × max(TLB, SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | ceil(Mmeas\_period\_irat × Kp) × max(TLB, DRX cycle) × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

The UE shall be capable of performing NR SS-RSRP, SS-RSRQ and SS-SINR for up to 7 NR carrier frequencies.

For each inter-RAT NR carrier frequency on FR1 or FR2, the UE shall be capable of monitoring at least 4 cells.

For each inter-RAT NR carrier frequency on FR1, during each layer 1 measurement period, the UE shall be capable of monitoring at least 7 SSBs with different SSB index and/or PCI.

For each inter-RAT NR carrier frequency on FR2, during each layer 1 measurement period, the UE shall be capable of monitoring at least 10 SSBs with different SSB index and/or PCI. The UE shall be capable of monitoring at least one SSB per cell.

The NR SS-RSRP measurement accuracy for all measured NR cells shall be as specified in clause 9.11.1. The NR SS-RSRQ measurement accuracy for all measured NR cells shall be as specified in clause 9.11.2. The NR SS-SINR measurement accuracy for all measured NR cells shall be as specified in clause 9.11.3.

8.1.2.4.z1.1.2 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in clause 9.

8.1.2.4.z1.1.3 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in clause 9.

The UE shall not send any event triggered measurement reports, as long as the reporting criteria are 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\_irat\_without\_index or Tidentify\_irat\_with\_index defined in Clause 8.1.2.4.z1.1.1 for the minimum requirements.When L3 filtering is used or IDC autonomous denial or the UE is performing reception and/or transmission for ProSe Direct Discovery and/or ProSe Direct Communication, or the UE is configured to perform SRS carrier based switching, an additional delay can be expected.

If an NR cell which has been detectable at least for the time period Tidentify\_irat\_without\_index. or Tidentify\_irat\_with\_index defined in clause 8.1.2.4.z1.1.1 for the minimum requirements and then triggers the measurement report as per TS 36.331 [2], the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_irat defined in clause 8.1.2.4.z1.1.1 provided the timing to that cell has not changed more than ±3200 Tc while measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used or IDC autonomous denial is configured or the UE is performing reception and/or transmission for ProSe Direct Discovery and/or ProSe Direct Communication, or the UE is configured to perform SRS carrier based switching, an additional delay can be expected.

8.1.2.4.z1.1.4 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in clause 9.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 8.1.2.4.z1.1.3.

8.1.2.4.z1.2 Sceduling availability of UE during E-UTRAN FDD – NR 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.

8.1.2.4.z1.2.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs inter-RAT NR measurements without measurement gap in a TDD band, the following restrictions apply due to 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 SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window.

When the UE performs inter-RAT NR measurements without measurement gap 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.

8.1.2.4.z1.2.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *TBD* the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement when the target inter-RAT NR 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/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 SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window.

##### 8.1.2.4.z2 E-UTRAN TDD – NR measurements without measurement gap

The requirements in clause 8.1.2.4.z1 also apply for this section.

**----------------------END OF CHANGE 2----------------------------**