**3GPP TSG-RAN4 Meeting #96-e *R4-2012099***

**Online, , 17th Aug 2020 - 28th Aug 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **1012** | **rev** | **1** | **Current version:** | **16.4.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:***  | CR to TS 38.133 to address NR-U inter-frequency measurements |
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| ***Source to WG:*** | Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | RAN4 |
|  |  |
| ***Work item code:*** | NR\_unlic-Core |  | ***Date:*** | 2020-08-07 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-16 |
|  | *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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | The CR updates the NR-U inter-frequency measurements section based on agreements made at previous meetings.  |
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| ***Summary of change:*** | Introduces a new clause 9.3A, including the agreements for inter-frequency measurements in carrier frequencies with CCA |
|  |  |
| ***Consequences if not approved:*** | The specification is incomplete.  |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | R4-2010594 |

<Start of Change 1>

##### 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.

9.3A NR inter-frequency measurements in carrier frequencies with CCA

9.3A.1 Introduction

 The requirements in section 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.

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.

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 clauses TBD ,

- SS-RSRQ related side conditions given in clauses TBD,

- SS-SINR related side conditions given in clauses TBD ,

- SSB\_RP and SSB Ês/Iot according to TBD.

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.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.

 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.

 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.

**Table 9.3A.4-1: Time period for PSS/SSS detection, (Frequency range 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 3.6.1NOTE 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: 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.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 SSB 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 (Frequency range 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 3.6.1NOTE 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: 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,maxNOTE 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 SSB 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 sub-clauses TBD, respectively, as shown in table 9.3A.5-1:

**Table 9.3A.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1)**

|  |  |
| --- | --- |
| **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 3.6.1NOTE 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: 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,maxNOTE 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 SSB 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.

When the time period of unsuccessful measurement attemps due to exceeding the maximum number of unavailable SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.3A.6.3, the UE shall stop the measurement attempts on this SSB and perform the detection procedure again, like for any other SSB.

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 TBD.

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 TBD.

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 TBD.

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. When L3 filtering is used an additional delay can be expected.

<End of Change 1>

<Start of Change 2>

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*.

**Table 9.3A.8-1: Measurement period for inter-frequency RSSI measurements with gaps (Frequency FR1)**

|  |  |
| --- | --- |
| **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 3.6.1NOTE 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 section shall meet the RSSI measurement accuracy requirement in Section TBD.

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.

**Table 9.3A.9-1: Measurement period for inter-frequency Channel Occupancy measurements with gaps (Frequency FR1)**

|  |  |
| --- | --- |
| **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 3.6.1NOTE 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 section shall meet the channel occupancy measurement accuracy requirements in Section TBD.

<End of Change 2>