**3GPP TSG-RAN WG4 Meeting # 111 R4-2408555**

Fukuoka City, Fukuoka , Japan, 20th – 24th May, 2024

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **36.133** | **CR** | **7321** | **rev** | **-** | **Current version:** | **18.5.0** |  |
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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 on core requirements maintenance for R18 IoT NTN |
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| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | LTE\_NBIOT\_eMTC\_NTN\_req-Core |  | ***Date:*** | 2024-05-01 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* *Rel-20 (Release 20)* |
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| ***Reason for change:*** | There is FFS on whehter to consider the time before epoch time is reached. The similar change shall be maded as NR NTN and the editor note shall be removed. |
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| ***Summary of change:*** | * Remove the editor note about FFS on time needee before epoch time is reached.
* Add necessary applicability conditions that ephemeris information shall be valid and applicable.
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| ***Consequences if not approved:*** | The requirements are incomplete. |
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| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 36.533 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

### <Start of Change 1>

### 5.5A.1 Introduction

This section defines the E-UTRAN intra-frequency handover requirements and inter-frequency handover and conditional handover requirements for Cat-M1 UEs for Satellite Access as required by TS 36.300 [25]. The requirements in this clause apply provided that the ephemeris information provided by the serving cell for the target cell is valid and applicable during Handover as defined in clause 5.5A.

#### 5.5A.2.1 E-UTRAN FDD – FDD HO for Cat-M1 FDD UEs

The requirements in this clause are applicable to FDD intra-frequency handovers and FDD inter-frequency handovers for a Cat-M1 FDD UE in CEModeA.

##### 5.5A.2.1.1 Handover delay

Procedure delays for all procedures that can command a handover are specified in TS 36.331 [2].

When the UE receives a RRC message implying handover the UE shall finish the transmission of all repetitions of the new uplink PRACH channel within Dhandover seconds from the end of the last TTI containing the RRC command,

Where:

- Dhandover equals the maximum RRC procedure delay to be defined in clause 11.2 in TS 36.331 [2] plus the interruption time stated in clause 5.5A.2.1.2.

##### 5.5A.2.1.2 Interruption time

The interruption time is the time between the end of the last TTI containing the RRC command on the old PDSCH and the moment the UE has transmitted all repetitions of PRACH in the target cell, excluding the RRC procedure delay. This requirement applies when UE is not required to perform any synchronisation procedure before transmitting on the new PRACH.

When intra-frequency handover or inter-frequency handover is commanded and the field *sameSFN-Indication* and *mib-RepetitionStatus* [2] are included in the handover command then the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + 20 ms

When intra-frequency handover or inter-frequency handover is commanded and the field *sameSFN-Indication* or *mib-RepetitionStatus* [2] is not included in the handover command then UE the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TMIB + TIU + 20 ms

Where:

- Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is unknown and signal quality is sufficient for successful cell detection on the first attempt, then Tsearch = 80 ms. Otherwise, Tsearch shall be according to the non-DRX cell identification requirements specified in Clause 8.13A.2.1 for intra-frequency handover for a UE configured with CEModeA or Tsearch shall be according to the non-DRX cell identification requirements specified in Clause 8.13A.2.2 for inter-frequency handover for a UE configured with CEModeA. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- TMIB is the time required for acquiring the MIB and SIB information of the target cell.

- TIU is the time required to complete the transmission of PRACH in the target cell. The actual value of TIU shall depend upon the uncertainity in acquiring the first available PRACH occasion based on the PRACH configuration used in the target cell and the PRACH coverage enhancement level used by the UE for sending the random access preamble to the target cell.

- In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement for a time duration equal or longer than the time duration required for the cell identification. Otherwise, it is unknown. For intra-frequency handover the time duration required for the cell identification is specified in relevant intra-frequency cell identification requirements as described in Clause 8.13A.2.1 for CEModeA. For inter-frequency handover the time duration required for the cell identification is specified in relevant inter-frequency cell identification requirements as described in Clause 8.13A.2.2 for CEModeA.

### < End of Change 1>

### <Start of Change 2>

#### 5.5A.3.1 E-UTRAN FDD – FDD HO for Cat-M1 FDD UEs

The requirements in this clause are applicable to FDD intra-frequency handovers and FDD inter-frequency handover for a Cat-M1 FDD UE configured with CEModeB.

##### 5.5A.3.1.1 Handover delay

Procedure delays for all procedures that can command a handover are specified in TS 36.331 [2].

When the UE receives a RRC message implying handover the UE shall finish the transmission of all repetitions of the new uplink PRACH channel within Dhandover seconds from the end of the last TTI containing the RRC command,

Where:

- Dhandover equals the maximum RRC procedure delay to be defined in clause 11.2 in TS 36.331 [2] plus the interruption time stated in clause 5.5A.3.1.2.

##### 5.5A.3.1.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay. This requirement applies when UE is not required to perform any synchronisation procedure before transmitting on the new PRACH.

When intra-frequency handover or inter-frequency handover is commanded and the field *sameSFN-Indication* and *mib-RepetitionStatus* [2] are included in the handover command then the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + 20 ms

When intra-frequency handover or inter-frequency handover is commanded and the field *sameSFN-Indication* or *mib-RepetitionStatus* [2] is not included in the handover command then the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TMIB + TIU + 20 ms

Where:

- Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is unknown and signal quality is sufficient for successful cell detection on the first attempt, then Tsearch = 80 ms. Otherwise, Tsearch shall be according to the non-DRX cell identification requirements specified in Clause 8.13A.3.1 for intra-frequency handover for a UE configured with CEModeB or Tsearch shall be according to the non-DRX cell identification requirements specified in Clause 8.13A.3.2 for inter-frequency handover for a UE configured with CEModeB. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- TMIB is the time required for acquiring the MIB and SIB information of the target cell.

- TIU is the time required to complete the transmission of PRACH in the target cell. The actual value of TIU shall depend upon the uncertainity in acquiring the first available PRACH occasion based on the PRACH configuration used in the target cell and the PRACH coverage enhancement level used by the UE for sending the random access preamble to the target cell.

- In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement for a time duration equal or longer than the time duration required for the cell identification. Otherwise, it is unknown. For intra-frequency handover the time duration required for the cell identification is specified in relevant intra-frequency cell identification requirements as described in Clause 8.13A.3.1 for CEModeB. For inter-frequency handover the time duration required for the cell identification is specified in relevant inter-frequency cell identification requirements as described in Clause 8.13A.3.2 for CEModeB.

### < End of Change 2>

### <Start of Change 3>

### 6.5A.1 Introduction

RRC connection re-establishment is initiated when a UE in RRC connected mode loses RRC connection due to any of these reasons: radio link failure or radio link problem. The RRC re-establishment procedure is specified in clause 5.3.7 in TS 36.331 [2].

The requirements in this clause are applicable for RRC connection re-establishment to a LTE cell, which is served by satellite access node (SAN). The requirements in this clause apply provided that the ephemeris information provided by the serving cell for the target cell is valid and applicable during UE re-establishment delay as specified in 6.5A.2. For GEO, when the satellite assistance information of neighbour cells in system information is not provided, the requirements in this clause apply for intra-frequency RRC Re-establishment.

### 6.5A.2 Requirements

In RRC connected mode the UE shall be capable of sending *RRCConnectionReestablishmentRequest* message within Tre-establish\_delay\_NB-IoT seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay\_NB-IoT) shall be less than:

Tre-establish\_delay\_NB-IoT = TUL\_grant + TUE\_re-establish\_delay\_NB-IoT

- TUL\_grant: It is the time required to acquire and process uplink grant from the target cell. The uplink grant is required to transmit *RRCConnectionReestablishmentRequest* message.

- The UE re-establishment delay (TUE\_re-establish\_delay\_NB-IoT) is specified in clause 6.5A.2.1 for a UE in normal coverage and in clause 6.5A.2.2 for a UE in enhanced coverage.

These requirements are not applicable for UEs that only support the Control Plane CIoT EPS optimisation (see TS 24.301). Connection control in NB-IoT is defined in Clause 5.3.1.4 in TS 36.331 [2].

#### 6.5A.2.1 UE Re-establishment delay requirement in normal coverage

The UE re-establishment delay (TUE\_re-establish\_delay\_NB-IoT) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 36.331 [2] is detected by the UE to the time when the UE sends PRACH preamble to the target cell. The UE re-establishment delay (TUE\_re-establish\_delay\_NB-IoT) requirement shall be less than:

$T\_{UE-re-establish\\_delay\\_NB-IoT}=100 ms+\sum\_{i=1}^{N\_{NB-IoT-freq}}T\_{search\\_NB1-NC,i}+T\_{SI\\_NB1-NC}+T\_{PRACH\\_NB-IoT}$- Tsearch\_NB1-NC,i: It is the time required by the UE to search the target cell:

- If the target cell is known, then Tsearch\_NB1-NC,i = 0 ms. If the target cell is unknown and signal quality is sufficient for successful cell detection on the first attempt, then Tsearch\_NB1-NC,i = Ksatellite \*80 ms. Otherwise, Tsearch\_NB1-NC,i = Ksatellite,i \*1400 ms. Where Ksatellite,i is defined as the number NGSO satellites to be measured on i-th frequency for RRC re-establishment. Ksatellite,i = 1, if GSO satellite(s) is/are measured on the carrier. Ksatellite,i equals to the number NGSO satellites to be measured on the carrier if NGSO satellites are monitored.

- TSI\_NB1-NC: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [2] for the target cell for a UE in normal coverage.

- TPRACH\_NB-IoT: The additional delay caused by the random access procedure. The actual value of TPRACH\_NB-IoT shall depend upon the NPRACH configuration used in the target cell and the number of repetition used by UE for sending random access to the target cell. There might be additional delay due to ramping procedure.

- NNB-Iot-freq: It is the total number of NB-IoT frequencies to be monitored for RRC re-establishment; NNB-Iot-freq = 1 if the target cell is known.

There is no requirement if the target cell does not contain the UE context.

#### 6.5A.2.2 UE Re-establishment delay requirement in enhanced coverage

The UE re-establishment delay (TUE\_re-establish\_delay\_NB-IoT) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 36.331 [2] is detected by the UE to the time when the UE sends PRACH preamble to the target cell. The UE re-establishment delay (TUE\_re-establish\_delay\_NB-IoT) requirement shall be less than:

$T\_{UE-re-establish\\_delay\\_NB-IoT}=100 ms+\sum\_{i=1}^{N\_{NB-IoT-freq}}T\_{search\\_NB1-EC,i}+T\_{SI\\_NB1-EC}+T\_{PRACH\\_NB-IoT}$- Tsearch\_NB1-EC: It is the time required by the UE to search the target cell:

- If the target cell is known, then Tsearch\_NB1-EC,i = 0 ms. If the target cell is unknown and signal quality is sufficient for successful cell detection on the first attempt, then Tsearch\_NB1-EC,i = Ksatellite \*80 ms. Otherwise, Tsearch\_NB1-EC,i = Ksatellite,i \*14800 ms. Where Ksatellite,i is defined as the number NGSO satellites to be measured on i-th frequency for RRC re-establishment. Ksatellite,i = 1, if GSO satellite(s) is/are measured on the carrier. Ksatellite,i equals to the number NGSO satellites to be measured on the carrier if NGSO satellites are monitored.

- TSI\_NB1-EC: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [2] for the target cell for a UE in enhanced coverage.

- TPRACH\_NB-IoT: The additional delay caused by the random access procedure. The actual value of TPRACH\_NB-IoT shall depend upon the NPRACH configuration used in the target cell and the number of repetition used by UE for sending random access to the target cell. There might be additional delay due to ramping procedure.

- NNB-Iot-freq: It is the total number of NB-IoT frequencies to be monitored for RRC re-establishment; NNB-Iot-freq = 1 if the target cell is known.

There is no requirement if the target cell does not contain the UE context.

### < End of Change 3>

### <Start of Change 4>

### 6.7A.1 Introduction

RRC connection re-establishment is initiated when a Cat-M1 UE either configured with CEModeA or CEModeB in RRC connected mode looses RRC connection due to any of these reasons: radio link failure or radio link problem. The RRC re-establishment procedure is specified in clause 5.3.7 in TS 36.331 [2].

The requirements in this clause are applicable for RRC connection re-establishment to E-UTRAN, which is served by satellite access node (SAN). The requirements in this clause apply provided that the ephemeris information provided by the serving cell for the target cell is valid and applicable during UE re-establishment delay as specified in 6.7A.2. For GEO, when the satellite assistance information of neighbour cells in system information is not provided, the requirements in this clause apply for intra-frequency RRC Re-establishment.

### 6.7A.2 Requirements

In RRC connected mode the UE shall be capable of sending *RRCConnectionReestablishmentRequest* message within Tre-establish\_delay seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay) shall be less than:

Tre-establish\_delay = TUL\_grant + TUE\_re-establish\_delay

- TUL\_grant: It is the time required to acquire and process uplink grant from the target cell. The uplink grant is required to transmit *RRCConnectionReestablishmentRequest* message.

- The UE re-establishment delay (TUE\_re-establish\_delay) is specified in clause 6.7A.2.1 for a UE configured with CEModeA and in clause 6.7A.2.2 for a UE configured with CEModeB.

#### 6.7A.2.1 UE Re-establishment delay requirement for CEModeA

The UE re-establishment delay (TUE\_re-establish\_delay) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 36.331 [2] is detected by the UE to the moment the UE has transmitted all repetitions of the PRACH preamble to the target cell. The UE re-establishment delay (TUE\_re-establish\_delay) requirement for a UE configured with CEModeA shall be less than:

$$T\_{UE\\_re-establish\\_delay}=50 ms+\sum\_{i=1}^{N\_{freq}}K\_{satellite,i}\*T\_{search}+T\_{SI\\_EUTRA-M1-CEModeA}+T\_{PRACH}$$

- Tsearch is the time required by the UE to search the target cell. Tsearch =100 ms if the target cell is known by the UE. Otherwise, Tsearch is specified in relevant intra-frequency cell identification requirements as described in Clause 8.13.2.1 for a UE configured with CEModeA. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

In the above requirement, a cell is known if it has been meeting the relevant cell identification requirement for a time duration equal to or longer than the time duration required for the cell identification. Otherwise, it is unknown.

- Ksatellite,i: It is the scaling factor for measurements correspond to multiple NGSO satellites to be monitored on i-th frequency for RRC re-establishment; Ksatellite,i  = [2] if NGSO satellites are monitored and one of the target NGSO satellites on the E-UTRA FDD carrier frequency is the serving satellite of the UE. Otherwise Ksatellite,i=1.

- TSI-EUTRA-M1-CEModeA: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [2] for the target cell for a UE configured with CEModeA. TSI-EUTRA-M1-CEModeA includes the time to acquire the MIB and all the relevant SIBs of the target cell.

- TPRACH is the interruption uncertainty in acquiring the first available PRACH occasion in the target cell. The actual value of TPRACH shall depend upon the PRACH configuration used in the target cell and the PRACH coverage enhancement level used by the UE for sending the random access to the target cell.

- Nfreq: It is the total number of frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target cell is known.

There is no requirement if the target cell does not contain the UE context.

#### 6.7A.2.2 UE Re-establishment delay requirement for CEModeB

The UE re-establishment delay (TUE\_re-establish\_delay) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 36.331 [2] is detected by the UE to the moment the UE has transmitted all repetitions of PRACH preamble to the target cell. The UE re-establishment delay (TUE\_re-establish\_delay) requirement for a UE configured with CEModeB shall be less than:

$$T\_{UE\\_re-establish\\_delay}=50 ms+\sum\_{i=1}^{N\_{freq}}K\_{satellite,i}\*T\_{search}+T\_{SI\_{EUTRA}-M1-CEModeB}+T\_{PRACH}$$

- Tsearch is the time required by the UE to search the target cell. Tsearch =100 ms if the target cell is known by the UE. Otherwise, Tsearch is specified in relevant intra-frequency cell identification requirements as described in Clause 8.13.3.1 for a UE configured with CEModeB. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

In the above requirement, a cell is known if it has been meeting the relevant cell identification requirement for a time duration equal to or longer than the time duration required for the cell identification. Otherwise, it is unknown.

- Ksatellite,i: It is the scaling factor for measurements correspond to multiple NGSO satellites to be monitored on i-th frequency for RRC re-establishment; Ksatellite,i  = [2] if NGSO satellites are monitored and one of the target NGSO satellites on the E-UTRA FDD carrier frequency is the serving satellite of the UE. Otherwise Ksatellite,i=1.

- TSI-EUTRA-M1-CEModeB: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [2] for the target cell for a UE configured with CEModeB; TSI-EUTRA-M1-CEModeB includes the time to acquire the MIB and all the relevant SIBs of the target cell.

- TPRACH is the interruption uncertainty in acquiring the first available PRACH occasion in the target cell. The actual value of TPRACH shall depend upon the PRACH configuration used in the target cell and the PRACH coverage enhancement level used by the UE for sending the random access to the target cell.

- Nfreq: It is the total number of frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target cell is known.

There is no requirement if the target cell does not contain the UE context.

### < End of Change 4>