**3GPP TSG- Meeting # *draft-***

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | **1** | **Current version:** |  |  |
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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 | **X** | Core Network |  |

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| ***Title:***  | Introduction of IoT-NTN Enhancements |
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| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** |  |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *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:*** | Introduction of IoT-NTN Enhancements |
|  |  |
| ***Summary of change:*** | 4.1 Changes to SystemInformation32 reception for carrier-frequency information and usage for cell selection process.5.2.4.2 : Changes to include distance based measurement triggering in idle mode cell reselection for Intra and Inter frequency neighboucell measurements for eMTC5.2.4.2a: Distance based measurement triggering for Intra and Inter frequency neighbour cell measurements for NB-IoT. 5.2.4.7: New parameters related to cell reselection parameters introduced for IoT-NTN enhancements are described. |
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| ***Consequences if not approved:*** | Idle mode functionality related to IoT-NTN enhancements is not specified. |
|  |  |
| ***Clauses affected:*** | 4.1,5.2.4.2,5.2.4.2a,5.2.4.7 |
|  |  |
|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

Start of changes

# 4 General description of Idle mode

## 4.1 Overview

The idle mode tasks can be subdivided into four processes:

- PLMN selection;

- Cell selection and reselection;

- Location registration;

- Support for manual CSG selection.

The relationship between these processes is illustrated in Figure 4.1-1.

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Figure 4.1-1: Overall Idle Mode process

When a UE is switched on, a public land mobile network (PLMN) is selected by NAS. For the selected PLMN, associated RAT(s) may be set TS 23.122 [5]. The NAS shall provide a list of equivalent PLMNs, if available, that the AS shall use for cell selection and cell reselection.

With the cell selection, the UE searches for a suitable cell of the selected PLMN and chooses that cell to provide available services, further the UE shall tune to its control channel. This choosing is known as "camping on the cell".

For E-UTRA a cell may be associated with more than one CN type (EPC and/or 5GC) and hence the selected cell can be suitable for more than one CN type. The CN type(s) for which the selected cell is suitable are reported to NAS which selects a CN type to be used for camping and for the NAS registration procedure (see below). Note that CN type selection is only applicabe for UE supporting E-UTRA connected to 5GC.

For E-UTRA a cell may be associated with more than one tracking area. The UE reports all the broadcasted tracking area codes in the selected cell to NAS for registration procedure.

The UE shall, if necessary, then register its presence, by means of a NAS registration procedure, in the tracking area of the chosen cell and as outcome of a successful Location Registration the selected PLMN becomes the registered PLMN TS 23.122 [5].

If the UE finds a more suitable cell, according to the cell reselection criteria, it reselects onto that cell and camps on it. Similar to cell selection procedure, if the reselected cell is an E-UTRA cell and the UE supports E-UTRA connected to 5GC, the CN type(s) for which the cell is suitable are reported to NAS which selects one of them. If the new cell does not belong to at least one tracking area to which the UE is registered, location registration is performed. In RRC\_INACTIVE state, if the new cell does not belong to the configured RNA, a RNA update procedure is performed.

If necessary, the UE shall search for higher priority PLMNs at regular time intervals as described in TS 22.011 [4] and search for a suitable cell if another PLMN has been selected by NAS.

Search of available CSGs may be triggered by NAS to support manual CSG selection.

If the UE loses coverage of the registered PLMN, either a new PLMN is selected automatically (automatic mode), or an indication of which PLMNs are available is given to the user, so that a manual selection can be made (manual mode).

Registration is not performed by UEs only capable of services that need no registration.

The UE may perform sidelink communication or V2X sidelink communication or sidelink discovery or NR sidelink communication while in-coverage or out-of-coverage for sidelink, as specified in clause 11.

The purpose of camping on a cell in idle mode is fivefold:

a) It enables the UE to receive system information from the PLMN.

b) When registered and if the UE wishes to establish an RRC connection, it can do this by initially accessing the network on the control channel of the cell on which it is camped.

c) If the PLMN receives a call for the registered UE, it knows (in most cases) the set of tracking areas (in RRC\_IDLE state) or RNAs (in RRC\_INACTIVE state) in which the UE is camped. It can then send a "paging" message for the UE on the control channels of all the cells in this set of tracking areas. The UE will then receive the paging message because it is tuned to the control channel of a cell in one of the registered tracking areas and the UE can respond on that control channel.

d) It enables the UE to receive ETWS and CMAS notifications.

e) It enables the UE to receive MBMS services.

If the UE is unable to find a suitable cell to camp on or if the location registration failed (except for LR rejected with cause #12, cause #14, cause #15 or cause #25, see TS 23.122 [5] and TS 24.301 [16]), it attempts to camp on a cell irrespective of the PLMN identity, and enters a "limited service" state.

When NAS indicates that PSM starts, the AS configuration (e.g. priorities provided by dedicated signalling and logged measurements) is kept, all running timers continue to run but the UE need not perform any idle mode tasks. If a timer expires while the UE is in PSM it is up to UE implementation whether it performs the corresponding action immediately or the latest when PSM ends. When NAS indicates that PSM ends, the UE shall perform all idle mode tasks.

If *SystemInformationBlockType32* has been received and if the UE has determined that it is out of coverage using available satellite assistance information (e.g. ephemeris parameters and coverage parameters in current or previously received *SystemInformationBlockType32*, *SystemInformationBlockType31*, *t-Service* in *SystemInformationBlockType3* or other parameters), the AS configuration (e.g. priorities provided by dedicated signalling and logged measurements) is kept, but the UE need not perform any idle mode tasks related to NTN. It is up to UE implementation to handle running timers. The detection of out of coverage using satellite assistance information is up to UE implementation and once in NTN coverage the UE shall perform all idle mode tasks related to NTN. If SystemInformationBlock32 includes *carrierFreqList* the UE may store this information and use for the cell selection process when UE resumes the idle mode task related to NTN once in NTN coverage

Next change

#### 5.2.4.2 Measurement rules for cell re-selection

For NB-IoT measurement rules for cell re-selection is defined in clause 5.2.4.2.a.

When evaluating Srxlev and Squal of non-serving cells for reselection purposes, the UE shall use parameters provided by the serving cell.

Following rules are used by the UE to limit needed measurements:

- If the measurements are performed using RSS as specified in [10] and the serving cell fulfils Srxlev> SIntraSearchP,

- If *distanceThresh* and *referenceLocation* are broadcasted in SIB31, and if UE supports location-based measurement initiation and has obtained its location information:

* If *referenceLocation* is *fixedCell*, the referenceLocation is used as serving cell reference location. If *referenceLocation* is  *movingCell* UE derives the serving reference location based on ephemeris, epochTime and referenceLocation and its current location.
* If the distance between UE and the serving cell reference location is shorter than *distanceThresh* the UE may choose not to perform intra-frequency measurements.
* Else, the UE shall perform intra-frequency measurements.

 - Else, the UE may choose not to perform intra-frequency measurements.

- Else if the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ, the UE may choose not to perform intra-frequency measurements.

- Otherwise, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for E-UTRAN inter-frequencies and inter-RAT frequencies which are indicated in system information and for which the UE has priority provided as defined in 5.2.4.1:

- For an E-UTRAN inter-frequency or inter-RAT frequency with a reselection priority higher than the reselection priority of the current E-UTRA frequency the UE shall perform measurements of higher priority E-UTRAN inter-frequency or inter-RAT frequencies according to TS 36.133 [10].

- For an E-UTRAN inter-frequency with an equal or lower reselection priority than the reselection priority of the current E-UTRA frequency and for inter-RAT frequency with lower reselection priority than the reselection priority of the current E-UTRAN frequency:

- If the measurements are performed using RSS as specified in [10] and the serving cell fulfils Srxlev > SnonIntraSearchP, -If *distanceThresh* and *referenceLocation* are broadcasted in SIB31, and if UE supports location-based measurement initiation and has obtained its location:

* + If *referenceLocation* is *fixedCell*, the referenceLocation is used as serving cell reference location. If *referenceLocation* is *movingCell* UE derives the serving reference location based on ephemeris, epochTime and referenceLocation and its current location.
	+ If the distance between UE and serving cell reference location is shorter than *distanceThresh* the UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority unless the UE is triggered to measure an E-UTRAN inter-frequency which is configured with redistributionInterFreqInfo.
	+ Else, the UE shall perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority according to TS 36.133 [10].

- Else, UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority unless the UE is triggered to measure an E-UTRAN inter-frequency which is configured with redistributionInterFreqInfo.

- Else if the serving cell fulfils Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ,

- If *distanceThresh* and *referenceLocation* are broadcasted in SIB31, and if UE supports location-based measurement initiation and has obtained its location:

* + If  *referenceLocation* is *fixedCell*, the referenceLocation is used as serving cell reference location. If *referenceLocation* is *movingCell* UE derives the serving reference location based on ephemeris, epochTime and referenceLocation and its current location.
	+ If the distance between UE and serving cell reference location is shorter than *distanceThresh* the UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority unless the UE is triggered to measure an E-UTRAN inter-frequency which is configured with redistributionInterFreqInfo.
	+ Else, the UE shall perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority according to TS 36.133 [10].

- Else, UE may choose not to perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority unless the UE is triggered to measure an E-UTRAN inter-frequency which is configured with redistributionInterFreqInfo.

- Otherwise,the UE shall perform measurements of E-UTRAN inter-frequencies or inter-RAT frequency cells of equal or lower priority according to TS 36.133 [10].

- If the UE supports relaxed monitoring and *s-SearchDeltaP* is present in *SystemInformationBlockType3*, the UE may further limit the needed measurements, as specified in clause 5.2.4.12.

If *t-Service* is present in *SystemInformationBlockType3* of the serving cell, UE shall perform intra-frequency, inter-frequency or inter-RAT measurements, before the time *t-Service* regardless whether the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ, or Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ. The exact time to start measurements before *t-Service* is up to UE implementation. UE shall perform measurements of higher priority inter-frequencies or inter-RAT frequencies regardless of the remaining service time of the serving cell.

#### 5.2.4.2a Measurement rules for cell re-selection for NB-IoT

When evaluating Srxlev and Squal of non-serving cells for reselection purposes, the UE shall use parameters provided by the serving cell.

Following rules are used by the UE to limit needed measurements:

- If the serving cell fulfils Srxlev> SIntraSearchP,

- If *distanceThresh* and *referenceLocation are* broadcasted in *SystemInformationBlock31-NB*, and if UE supports location-based measurement initiation and has obtained its location:

* + If *referenceLocation* is *fixedCell*, the referenceLocation is used as serving cell reference location. If *referenceLocation* is *movingCell* UE derives the serving reference location based on ephemeris, epochTime and referenceLocation and its current location.
	+ If the distance between UE and serving cell reference location is shorter than *distanceThresh* the UE may choose not to perform intra-frequency measurements.
	+ Else, the UE shall perform intra-frequency measurements.

 - Else, the UE may choose not to perform intra-frequency measurements.

- Otherwise, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for NB-IoT inter-frequencies which are indicated in system information:

- If the serving cell fulfils Srxlev > SnonIntraSearchP,

- If *distanceThresh* and *referenceLocation are* broadcasted in *SystemInformationBlock31-NB*, and if UE supports location-based measurement initiation and has obtained its location:

* + If *referenceLocation* is *fixedCell*, the referenceLocation is used as serving cell reference location. If  *referenceLocation* is *movingCell* UE derives the serving reference location based on ephemeris, epochTime and referenceLocation and its current location.
	+ If the distance between UE and serving cell reference location is shorter than *distanceThresh* the UE may choose not to perform inter-frequency measurements.
	+ Else, the UE shall perform inter-frequency measurements.

 - Else, the UE may choose not to perform inter-frequency measurements.

- Otherwise,the UE shall perform inter-frequency measurements.

- If the UE supports relaxed monitoring and *s-SearchDeltaP* is present in *SystemInformationBlockType3-NB*, the UE may further limit the needed measurements, as specified in clause 5.2.4.12.

If *t-Service* is present in *SystemInformationBlockType3-NB* of the serving cell, UE shall perform intra-frequency or inter-frequency measurements before the time *t-Service* regardless whether the serving cell fulfils Srxlev> SIntraSearchP or Srxlev > SnonIntraSearchP. The exact time to start measurements before *t-Service* is upon the *t-ServiceStartNeigh* for the corresponding neighbour satellite if it is present in *SystemInformationBlockTypeXX* or up to UE implementation.

Next Change

#### 5.2.4.7 Cell reselection parameters in system information broadcasts

Cell reselection parameters are broadcast in system information and are read from the serving cell as follows:

**altCellReselectionPriority**

This specifies the absolute priority of E-UTRAN frequency used by the UE, if *altFreqPriorities* is configured.

**altCellReselectionSubPriority**

This specifies fractional priority value added to *altCellReselectionPriority* for E-UTRAN frequency used by the UE, if *altFreqPriorities* is configured.

**cellReselectionPriority**

This specifies the absolute priority for E-UTRAN frequency or NR frequency or UTRAN frequency or group of GERAN frequencies or band class of CDMA2000 HRPD or band class of CDMA2000 1xRTT.

**cellReselectionSubPriority**

This specifies the fractional priority value added to cellReselectionPriority for E-UTRAN frequency or NR frequency.

**distanceThresh**

This specifies the distance threshold from serving cell that is used by UE to be used in distance based measurement initiation.

**nrs-PowerOffsetNonAnchor**

This specifies the power offset of the downlink narrowband reference-signal EPRE of the anchor/non-anchor carrier relative to the anchor carrier for NB-IoT UE.

**Poffset**

This specifies the offset for 14 dBm power class for BL or NB-IoT UE.

**Qoffsetauthorization**

This specifies the offset for enhanced coverage authorization for NB-IoT.

**Qoffsets,n**

This specifies the offsetbetween the two cells.

**Qoffsetfrequency**

Frequency specific offset for equal priority E-UTRAN frequencies.

**Qoffsetscptm**

This specifies the offset to be used for cell re-selection for SC-PTM service reception for BL UE, UE in enhanced coverage and NB-IoT UE. The same offset is applicable to all frequencies providing MBMS services via SC-PTM.

**Qoffsettemp**

This specifies the additional offset to be used for cell selection and re-selection. It is temporarily used in case the T300 expires consecutively on the cell as specified in TS 36.331 [3].

**Qhyst**

This specifies the hysteresis value for ranking criteria.

**Qqualmin**

This specifies the minimum required quality level in the cell in dB.

**Qqualmin\_CE, Qqualmin\_CE1**

This specifies the coverage specific minimum required quality level in the cell in dB.

**Qrxlevmin**

This specifies the minimum required Rx level in the cell in dBm.

**Qrxlevmin\_CE, Qrxlevmin\_CE1**

This specifies the coverage specific minimum required Rx level in the cell in dBm.

**RedistributionFactorFreq**

This specifies the redistribution factor for a neighbour E-UTRAN frequency.

**RedistributionFactorCell**

This specifies the redistribution factor for a neighbour E-UTRAN cell.

**RedistributionFactorServing**

This specifies the redistribution factor for serving cell or serving frequency.

**referenceLocation**

This specifies the referenceLocation of the serving satellite and also whether the serving cell is fixed cell or moving cell, to be used in distance based measurement initiation.

**TreselectionRAT**

This specifies the cell reselection timer value. For each target E-UTRA frequency and for each RAT (other than E-UTRA) a specific value for the cell reselection timer is defined, which is applicable when evaluating reselection within E-UTRAN or towards other RAT (i.e. TreselectionRAT for E-UTRAN is TreselectionEUTRA, for NR TreselectionNR, for UTRAN TreselectionUTRA for GERAN TreselectionGERA, for TreselectionCDMA\_HRPD, and for TreselectionCDMA\_1xRTT). For NB-IoT intra-frequency and inter-frequency specific values for the cell reselection timer are defined, which are applicable when evaluating reselection within NB-IoT.

NOTE: TreselectionRAT is not sent on system information, but used in reselection rules by the UE for each RAT.

**TreselectionEUTRA\_ CE**

This specifies the cell reselection timer value TreselectionRAT for E-UTRAN when a neighbour cell is evaluated for camping in enhanced coverage. The parameter can be set per E-UTRAN frequency.

**TreselectionEUTRA**

This specifies the cell reselection timer value TreselectionRAT for E-UTRAN. The parameter can be set per E-UTRAN frequency TS 36.331 [3].

**TreselectionNR**

This specifies the cell reselection timer value TreselectionRAT for NR.

**TreselectionNB-IoT\_Intra**

This specifies the intra-frequency cell reselection timer value TreselectionRAT for NB-IoT.**TreselectionNB-IoT\_Inter**

This specifies the inter-frequency cell reselection timer value TreselectionRAT for NB-IoT.

**TreselectionUTRA**

This specifies the cell reselection timer value TreselectionRAT for UTRAN.

**TreselectionGERA**

This specifies the cell reselection timer value TreselectionRAT for GERAN.

**TreselectionCDMA\_HRPD**

This specifies the cell reselection timer value TreselectionRAT for CDMA HRPD.

**TreselectionCDMA\_1xRTT**

This specifies the cell reselection timer value TreselectionRAT for CDMA 1xRTT.

**Tservice**

This indicates the time when a quasi-Earth fixed cell is going to stop serving the area it is currently covering, to be used in time-based measurement initiation.

**TserviceStartNeigh**

This indicates the time when a quasi-Earth fixed neighbour satellite cell is going to start serving the coverage area currently served by the serving cell, to be used in time-based measurement initiation.

**ThreshX, HighP**

This specifies the Srxlev threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN, NR and UTRAN, each group of GERAN frequencies, each band class of CDMA2000 HRPD and CDMA2000 1xRTT might have a specific threshold.

**ThreshX, HighQ**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN, NR and UTRAN FDD might have a specific threshold.

**ThreshX, LowP**

This specifies the Srxlev threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN, NR and UTRAN, each group of GERAN frequencies, each band class of CDMA2000 HRPD and CDMA2000 1xRTT might have a specific threshold.

**ThreshX, LowQ**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of E-UTRAN, NR and UTRAN FDD might have a specific threshold.

**ThreshServing, LowP**

This specifies the Srxlev threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**ThreshServing, LowQ**

This specifies the Squal threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**SIntraSearchP**

This specifies the Srxlev threshold (in dB) for intra-frequency measurements.

**SIntraSearchQ**

This specifies the Squal threshold (in dB) for intra-frequency measurements.

**SnonIntraSearchP**

This specifies the Srxlev threshold (in dB) for E-UTRAN inter-frequency and inter-RAT measurements.

**SnonIntraSearchQ**

This specifies the Squal threshold (in dB) for E-UTRAN inter-frequency and inter-RAT measurements.

**SSearchDeltaP**

This specifies the Srxlev delta threshold (in dB) during relaxed monitoring.

End Of Changes