**3GPP TSG-RAN WG2 Meeting #117-e *R2-220xxxx***

**E-meeting, 21st February – 3rd March 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **36.304** | **CR** | **0843** | **rev** | **1** | **Current version:** | **16.6.0** |  |
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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 |  | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of IoT NTN Idle mode | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | LTE\_NBIOT\_eMTC\_NTN | | | | |  | ***Date:*** | | | 2022-02-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***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 can be 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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of NTN in idle mode for NB-IoT and eMTC connected to EPC | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This CR captures agreements for support of NTN in NB-IoT and eMTC from RAN2#115-e, RAN2#116-e and RAN2#116bis-e, excluding editor’s notes:  - Section 3: Definitions and abbreviations of NTN.  - Section 4.1: Description of providing multiple TACs per PLMN and discontinuous coverage UE behaviour.  - Section 5.2.4: Capturing agreement of UE starting measurements before t-Service.  - Section 5.3.1 Capturing cell barring in NTN. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | NTN is not supported for NB-IoT and eMTC. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.3, 4.1, 5.2.4, 5.3.1, | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **Y** |  | Other core specifications | | | | TS 36.331 CR ...  TS 36.321 CR …  TS 36.300 CR … | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | R2-2203455: Version 0 submitted to RAN2#117-e  R2-2202013: Noted version from RAN2bis-e on top of 16.6.0  R2-2111631: Endorsed version from RAN2#116-e on top of v16.5.0.  R2-2108975: Endorsed version from RAN2#115-e on top of v16.4.0. | | | | | | | | |

Start of change

# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**Acceptable Cell:** A cell that satisfies certain conditions as specified in 4.3. A UE can always attempt emergency calls on an acceptable cell, but restriction as in 5.3.3 apply.

**Alternative cell reselection priority:** Cell reselection priority broadcast in the system information via*altCellReselectionPriority* and *altCellReselectionSubPriority*.

**CSG Whitelist**: A list provided by NAS containing all the CSG identities and their associated PLMN IDs of the CSGs to which the subscriber belongs.

NOTE: This list is known as Allowed CSG List in Rel-8 Access Stratum specifications.

**Available PLMN(s):** One or more PLMN(s) for which the UE has found at least one cell and read its PLMN identity(ies).

**Barred Cell**: A cell a UE is not allowed to camp on.

**Camped on a cell:** UE has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information.

**Camped on any cell**: UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell irrespective of PLMN identity.

**Closed Subscriber Group (CSG):** A Closed Subscriber Group identifies subscribers of an operator who are permitted to access one or more cells of the PLMN but which have restricted access (CSG cells).

**CN type:** The type of core network connectivity supported by an E-UTRA cell, either EPC or 5GC.

**Commercial Mobile Alert System:** Public Warning System that delivers *Warning Notifications* provided by *Warning Notification Providers* to CMAS capable UEs.

**CSG cell:** A cell broadcasting a CSG indication that is set to TRUE and a specific CSG identity.

**CSG identity:** An identifier broadcast by a CSG or hybrid cell/cells and used by the UE to facilitate access for authorised members of the associated Closed Subscriber Group.

**CSG member cell:** a cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN and for which the CSG whitelist of the UE includes an entry comprising cell's CSG ID and the respective PLMN identity.

**DRX cycle:** Individual time interval between monitoring Paging Occasion for a specific UE.

**eDRX cycle:** Time interval between the first Paging Occasions occurring after successive extended DRX periods.

**eCall Only Mode:** A UE configuration option that allows the UE to attach at EPS and register in IMS to perform only eCall Over IMS, and a non-emergencyIMS call for test and/or terminal reconfiguration services.

**EHPLMN:** Any of the PLMN entries contained in the Equivalent HPLMN list TS 23.122 [5].

**Equivalent PLMN list:** List of PLMNs considered as equivalent by the UE for cell selection, cell reselection, and handover according to the information provided by the NAS.

**EU-Alert:** Public Warning System that delivers Warning Notifications provided by Warning Notification Providers using the same AS mechanisms as defined for CMAS.

**Home PLMN:** A PLMN where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the IMSI.

**HNB Name**: The Home eNodeB Name is a broadcast string in free text format that provides a human readable name for the Home eNodeB CSG identity and any broadcasted PLMN identity.

**HSDN cell**: A cell that has higher priority than other cells for cell reselection for HSDN capable UE in a High-mobility state.

**Hybrid cell:** A cell broadcasting a CSG Indicator that is set to FALSE and a specific CSG identity.

**Hyper SFN:** Index broadcast in System Information that increments at every SFN wrap around (i.e every 10.24s).

**Korean Public Alert System (KPAS):** Public Warning System that delivers Warning Notifications provided by Warning Notification Providers using the same AS mechanisms as defined for CMAS.

**Location Registration (LR):** UE registers its presence in a registration area, for instance regularly or when entering a new tracking area.

**MBMS-dedicated cell**: cell dedicated to MBMS transmission.

**MBMS/****Unicast-mixed cell**: cell supporting both unicast and MBMS transmissions.

**FeMBMS/Unicast-mixed cell**: cell supporting MBMS transmission and unicast transmission as SCell.

**NB-IoT:** NB-IoT allows access to network services via E-UTRA with a channel bandwidth limited to 200 kHz.

**Non-Terrestrial Network:** An E-UTRAN consisting of eNBs, which provide non-terrestrial LTE access to UEs by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway.

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [40], between two or more nearby UEs, using NR technology but not traversing any network node.

**Paging Time Window:** The period configured for a UE in extended DRX, during which the UE monitors Paging Occasions following DRX cycle.

**Power saving mode**: Mode allowing the UE to reduce its power consumption, as defined in TS 24.301 [16], TS 23.401 [23], TS 23.682 [24].

**Process:** A local action in the UE invoked by a RRC procedure or an Idle Mode or RRC\_INACTIVE state procedure.

**Radio Access Technology:** Type of technology used for radio access, for instance E-UTRA, UTRA, GSM, CDMA2000 1xEV-DO (HRPD) or CDMA2000 1x (1xRTT).

**Registered PLMN:** This is the PLMN on which certain Location Registration outcomes have occurred TS 23.122 [5].

**Registration Area**: (NAS) registration area is an area in which the UE may roam without a need to perform location registration, which is a NAS procedure.

**Reserved Cell**: A cell on which camping is not allowed, except for particular UEs, if so indicated in the system information.

**Restricted Cell**: A cell on which camping is allowed, but access attempts are disallowed for UEs whose access classes are indicated as barred.

**Selected PLMN:** This is the PLMN that has been selected by the NAS, either manually or automatically.

**Serving cell:** The cell on which the UE is camped.

**Sidelink**: UE to UE interface for sidelink communication, V2X sidelink communication and sidelink discovery. The Sidelink corresponds to the PC5 interface as defined in TS 23.303 [29].

**Sidelink communication**: AS functionality enabling ProSe Direct Communication as defined in TS 23.303 [29], between two or more nearby UEs, using E-UTRA technology but not traversing any network node. The terminology "sidelink communication" without "V2X" prefix only concerns PS unless specifically stated otherwise.

**Sidelink discovery**: AS functionality enabling ProSe Direct Discovery as defined in TS 23.303 [29], using E-UTRA technology but not traversing any network node.

**Strongest cell:** The cell on a particular carrier that is considered strongest according to the layer 1 cell search procedure TS 36.213 [6], TS 36.214 [7].

**Suitable Cell:** This is a cell on which an UE may camp. For a E-UTRA cell, the criteria are defined in clause 4.3, for a UTRA cell in TS 25.304 [8], for a GSM cell in TS 43.022 [9], and for a NR cell in TS 38.304 [38].

**V2X sidelink communication:** AS functionality enabling V2X Communication as defined in TS 23.285 [36], between nearby UEs, using E-UTRA technology but not traversing any network node.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

1xRTT CDMA2000 1x Radio Transmission Technology

AS Access Stratum

AC Access Class (of the USIM)

ACDC Application specific Congestion control for Data Communication

BCCH Broadcast Control Channel

BL Bandwidth reduced Low complexity

BR-BCCH Bandwidth Reduced Broadcast Control Channel

BSS Basic Service Set

CMAS Commercial Mobile Altert System

CSG Closed Subscriber Group

DRX Discontinuous Reception

DL-SCH Downlink Shared Channel

EHPLMN Equivalent Home PLMN

EPC Evolved Packet Core

EPS Evolved Packet System

ETWS Earthquake and Tsunami Warning System

E-UTRA Evolved UMTS Terrestrial Radio Access

E-UTRAN Evolved UMTS Terrestrial Radio Access Network

FDD Frequency Division Duplex

GERAN GSM/EDGE Radio Access Network

GWUS Group Wake Up Signal

HPLMN Home PLMN

HSDN High Speed Dedicated Network

H-SFN Hyper System Frame Number

HRPD High Rate Packet Data

IAB Integrated Access and Backhaul

IMSI International Mobile Subscriber Identity

MBMS Multimedia Broadcast-Multicast Service

MBSFN Multimedia Broadcast multicast service Single Frequency Network

MCC Mobile Country Code

MCCH Multicast Control Channel

MDT Minimization of Drive Tests

MM Mobility Management

MNC Mobile Network Code

MPDCCH MTC Physical Downlink Control Channel

MTCH Multicast Traffic Channel

NAS Non-Access Stratum

NB-IoT NarrowBand Internet of Things

NR NR Radio Access

NRS Narrowband Reference Signal

NTN Non-Terrestrial Network

PLMN Public Land Mobile Network

ProSe Proximity-based Services

PSM Power Saving Mode

PTW Paging Time Window

PWS Public Warning System

RAT Radio Access Technology

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RRC Radio Resource Control

SAP Service Access Point

SIBX SystemInformationBlockTypeX

TDD Time Division Duplex

UAC Unified Access Control

UE User Equipment

UMTS Universal Mobile Telecommunications System

USIM Universal Subscriber Identity Module

UTRA UMTS Terrestrial Radio Access

UTRAN UMTS Terrestrial Radio Access Network

V2X Vehicle-to-Everything

WUS Wake Up Signal

# 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.

**

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 the UE has determined that it is out of coverage using available satellite assistance information (e.g ephemeris parameters and coverage parameters in *SystemInformationBlockTypeYY*, *SystemInformationBlockTypeXX* or other parameters), the AS configuration (e.g. priorities provided by dedicated signalling and logged measurements) is kept, but the UE need to perform any idle mode tasks. 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 coverage the UE shall perform all idle mode tasks.

Editor’s Note: FFS which parameters may be used for determining out of coverage and how network can configure that a UE may determine that it is out of coverage, i.e through configuring SIByy or not.

End of change

Start of 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, 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, 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 if the serving cell fulfils Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, 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*.

- 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 should start to perform intra-frequency or inter-frequency measurements, where the UE does not limit the needed measurements, before the time *t-Service*. 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, 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, 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 *SystemInformationBlockTypeXX-NB* of the serving cell, UE should start to perform intra-frequency or inter-frequency measurements, where the UE does not limit the needed measurements, before the time *t-Service*.

End of change

Start of change

## 5.3 Cell Reservations and Access Restrictions

There are two mechanisms which allow an operator to impose cell reservations or access restrictions. The first mechanism uses indication of cell status and special reservations for control of cell selection and reselection procedures. The second mechanism, referred to as Access Control, shall allow preventing selected classes of users or ACDC categories from sending initial access messages for load control reasons. For Access Control based on Access Classes, at subscription, one or more Access Classes are allocated to the subscriber and stored in the USIM TS 22.011 [4]. For Access Control based on ACDC categories, at subscription at least four ACDC categories are allocated to the subscriber and stored in the ACDC MO TS 24.105 [31] or USIM TS 31.102 [32].

IAB-MT does not apply the access control.

### 5.3.1 Cell status and cell reservations

Cell status and cell reservations are indicated in the *SystemInformationBlockType1* message (or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB* message) TS 36.331 [3] by means of the following fields:

- *cellBarred* (IE type: "barred" or "not barred")   
This field indicates if the cell is barred for connectivity to EPC.  
This field is ignored by the UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.   
This field is ignored by the BL UEs or UEs in CE supporting *ce-CRS-IntfMitig* while *crs-IntfMigitNumPRBs* is included in SIB1-BR.  
This field is ignored by UEs supporting NTN while *cellBarred-NTN* is included in SIB1-BR or SIB1-NB.   
In case of multiple EPC PLMNs indicated in SIB1/SIB1-BR, this field is common for all EPC PLMNs

Editor’s Note: FFS how an NTN-only UE is barred from accessing TN cell.

NOTE 1: IAB-MT ignores the *cellBarred*, *cellReservedForOperatorUse* and *intraFreqReselection* (i.e. treats *intraFreqReselection* as if it was set to *allowed*) as defined in TS 36.331 [3].

- *cellBarred-5GC* (IE type: "barred" or "not barred")  
This field indicates if the cell is barred for connectivity to 5GC.  
This field is ignored if the UE does not support E-UTRA connected to 5GC or if the UE supports network-based CRS interference mitigation and *nw-BasedCRS-InterferenceMitigation* is included in *SystemInformationBlockType1*.  
In case of multiple 5GC PLMNs indicated in SIB1, this field is common for all 5GC PLMNs.

- *cellReservedForOperatorUse* (IE type: "reserved" or "not reserved")  
This field indicates if the cell is reserved for operator use.  
This field is ignored by the UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.   
This field is ignored by the BL UEs or UEs in CE supporting *ce-CRS-IntfMitig* while *crs-IntfMigitNumPRBs* is included in SIB1-BR.   
In case of multiple EPC or 5GC PLMNs indicated in SIB1/SIB1-BR, this field is specified per EPC or 5GC PLMN.

- *cellBarred-CRS* (IE type: "barred" or "not barred")  
This field indicates if the cell is barred for connectivity to EPC for UEs supporting network-based CRS interference mitigation.  
*barred* means the cell is barred for UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1. For BL UEs or UEs in CE capable of *ce-CRS-IntfMitig*, *barred* means the cell is barred while *crs-IntfMitigNumPRBs* is included in SIB1-BR.  
This field is ignored by the UE if the UE does not support CRS interference mitigation or while *crs-IntfMitigConfig* is not included in SIB1 (SIB1-BR for BL UEs or UEs in CE).  
In case of multiple PLMNs indicated in SIB1/SIB1-BR, this field is common for all PLMNs.

- *cellBarred-5GC-CRS* (IE type: "barred" or "not barred")  
This field indicates if the cell is barred for connectivity to 5GC for UEs supporting network-based CRS interference mitigation.  
This field is ignored if the UE does not support E-UTRA connected to 5GC or network-based CRS interference mitigation.  
In case of multiple 5GC PLMNs indicated in SIB1, this field is common for all 5GC PLMNs.

- *cellReservedForOperatorUse-CRS* (IE type: "reserved" or "not reserved")  
This field indicates if the cell is reserved for operator use for UEs supporting network-based CRS interference mitigation.  
*reserved* means the cell is "reserved" for operator use for UEs supporting *crs-IntfMitig* while *crs-IntfMitigEnabled* is included in SIB1.   
For BL UEs or UEs in CE capable of *ce-CRS-IntfMitig*, *reserved* means the cell is "reserved" for operator use while *crs-IntfMitigNumPRBs* is included in SIB1-BR.  
This field is ignored if the UE does not support CRS interference mitigation or while *crs-IntfMitigConfig* is not included in SIB1 (SIB1-BR for BL UEs or UEs in CE).  
In case of multiple PLMNs indicated in SIB1/SIB1-BR, this field is specified per PLMN.

- *iab-Support* (IE type: "true")

Indicated in *SIB1* message. In case of multiple PLMNs indicated in *SIB1*, this field is specified per PLMN. This field indicates if the cell is barred for IAB node or the cell does not support IAB node, or both. When this field is absent, the IAB node shall treat this cell as if cell status is barred.

- *cellBarred-NTN* (IE type: "barred" or “not barred”)  
This field indicates if the cell is barred for connectivity to EPC via NTN.   
This field is ignored if the UE does not support NTN connectivity.

The following description for handling of barred and reserved cells is per CN type. If the UE supports more than one CN type, the UE shall only exclude a cell as candidate for selection/reselection if it is excluded for both CN types.

NOTE 2: Fields *cellBarred-CRS* and *cellReservedForOperatorUse-CRS* are not indicated in *SystemInformationBlockType1-NB*

When cell status is indicated as "not barred" and "not reserved" for operator use,

- All UEs shall treat this cell as candidate during the cell selection and cell reselection procedures.

When cell status is indicated as "not barred" and "reserved" for operator use for any PLMN,

- UEs assigned to Access Class 11 or 15 operating in their HPLMN/EHPLMN shall treat this cell as candidate during the cell selection and reselection procedures if the field *cellReservedForOperatorUse* for that PLMN set to "reserved".

- UEs assigned to an Access Class in the range of 0 to 9, 12 to 14 shall behave as if the cell status is "barred" in case the cell is "reserved for operator use" for the registered PLMN or the selected PLMN.

NOTE 3: ACs 11, 15 are only valid for use in the HPLMN/ EHPLMN; ACs 12, 13, 14 are only valid for use in the home country TS 22.011 [4].

When cell status "barred" is indicated or to be treated as if the cell status is "barred",

- The UE is not permitted to select/reselect this cell, not even for emergency calls.

- The UE shall consider other cells for cell selection/reselection according to the following rule:

- If the cell is to be treated as if the cell status is "barred" due to being unable to acquire the *MasterInformationBlock (*or *MasterInformationBlock-NB),* the *SystemInformationBlockType1 (*or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB),* or the *SystemInformationBlockType2 (*or *SystemInformationBlockType2-NB)*:

- the UE may exclude the barred cell as a candidate for cell selection/reselection for up to 300 seconds.

- the UE may select another cell on the same frequency if the selection criteria are fulfilled.

- the UE may select the same cell in normal coverage if the UE was barred in the cell due to being unable to acquire *MasterInformationBlock*, *SystemInformationBlockType1-BR*, or *SystemInformationBlockType2* in enhanced coverage, but was able to acquire *MasterInformationBlock*, *SystemInformationBlockType1*, and *SystemInformationBlockType2* in normal coverage, if the selection criteria are fulfilled.

- the UE may select the same cell in enhanced coverage if the UE was barred in the cell due to being unable to acquire *MasterInformationBlock*, *SystemInformationBlockType1*, or *SystemInformationBlockType2* in normal coverage, but was able to acquire *MasterInformationBlock*, *SystemInformationBlockType1-BR*, and *SystemInformationBlockType2*, if the selection criteria are fulfilled.

- else

- If the cell is a CSG cell:

- the UE may select another cell on the same frequency if the selection/reselection criteria are fulfilled.

- else

- If the field *intraFreqReselection* in field *cellAccessRelatedInfo* in *SystemInformationBlockType1 (*or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB)* message is set to "allowed", the UE may select another cell on the same frequency if re-selection criteria are fulfilled.

- The UE shall exclude the barred cell as a candidate for cell selection/reselection for 300 seconds.

- If the field *intraFreqReselection* in field *cellAccessRelatedInfo* in *SystemInformationBlockType1* (or *SystemInformationBlockType1-BR* message or *SystemInformationBlockType1-NB*) message is set to "not allowed" the UE shall not re-select a cell on the same frequency as the barred cell;

- The UE shall exclude the barred cell and the cells on the same frequency as a candidate for cell selection/reselection for 300 seconds.

The cell selection of another cell may also include a change of RAT or, if the previous and selected cell are both E-UTRA cells, a change of the CN type.

End of change

Start of change

## 5.4 Tracking Area registration

In the UE, the AS shall report tracking area information to the NAS.

If the UE reads more than one PLMN identity in the current cell, the UE shall report the found PLMN identities that make the cell suitable in the tracking area information to NAS.

The NAS part of the location registration process is specified in TS 23.122 [5].

Actions for the UE AS upon reception of Location Registration reject are specified in TS 22.011 [4] and TS 24.301 [16].

End of change

Start of change

# 6 Reception of broadcast information

## 6.1 Reception of system information

The NAS is informed if the cell selection and reselection results in changes in the received NAS system information.

The UE shall monitor the Paging Occasions (POs) as described in clause 7.1 to receive System Information change notifications in RRC\_IDLE. Changes in the system information are indicated by the network using a *Paging* message or Direct Indication information on MPDCCH and NPDCCH respectively. When the *Paging* message or Direct Indication information indicates system information changes then the UE shall re-acquire the concerned system information, as specified in TS 36.331 [3].

End of change

# Annex – Agreements related to idle mode in NTN

## RAN2#115-e

Agreements:

* RAN2 confirms that the following will be supported: discontinuous coverage without excessive UE power consumption and without excessive failures / recovery actions. It is expected that this need to be taken into account at least for Idle mode. The requirement is applicable for all reference scenarios (GEO, MEO and LEO).
* Sattelite assistance information will be used by the UE for predicting coverage discontinuity. The details of the assistance information is FFS. FFS whether any applicable agreements made in NR-NTN can be reused.
* The details of UEs actions when predicted to be out of coverage is FFS, e.g. stopping unnecessary cell search in the Idle mode, and FFS to what extent this need to be specified.
* It is FFS to what extent it need to be specified the details of UE’s prediction of discontinuous coverage and its ability to detect when it is back in coverage.
* Cell selection / reselection procedures for NB-IoT and LTE-M in TN is the baseline in NB-IoT/LTE-M NTN.
* RAN2 assumes that Satellite assistance information, e.g. for cell selection reselection, for serving cell is provided to UE.
* The timing information on when a cell is going to stop serving the area is broadcast at least for the quasi-earth fixed case. FFS details.
* The network may broadcast more than one TAC per PLMN in a cell, which is up to network implementation.
* The UE determines the Tracking Area based on the broadcast information (the use of other information is not excluded).
* When the network stops broadcasting a TAC, the UE needs to know it. FFS how this is done.
* UE does not do TAU if one of the currently broadcasted TAC belongs to UE’s registration area.
* FFS if Satellite assistance information for neighbour cell(s) is provided to UE for cell selection/reselection (justification would be needed).
* System information update notification procedure is not used to inform TAC updates, at least for TAC additions (FFS removals)

## RAN2#116-e

Agreements:

* Satellite Ephemeris Parameters (not same as for L1 pre-compensation, for the constellation, not just single satellite) is needed for the UE predicting coverage discontinuity. Other info, e.g. beam info, elevation angle, reference location or corresponding is FFS.
* Providing the start-time of (incoming) satellite’s coverage and end-time of serving satellite’s coverage is needed.
* From RAN2 point of view, the existing power saving mechanisms e.g. DRX, PSM, eDRX, relaxed monitoring, and WUS can be reused in IoT-NTN. Minor enhancements in existing power saving mechanisms to support discontinuous coverage is FFS.
* The AS layer indicates to NAS layer all of the received TACs for the selected PLMN.
* For quasi-earth fixed cell, UE should start measurements on neighbouring cells before the broadcast stop time of the serving cell, i.e the time when the serving cell stops covering the current area, and the exact time to start measurements (inter and intra-frequency) is up to UE implementation. FFS to what extent this need to be covered in the TS.
* Location-assisted cell reselection (e.g. as for IoT NTN) is not supported for IoT NTN in rel 17.
* The use of hard TAC or soft TAC is up to network implementation in earth-fixed and earth-moving cells.
* Relaxed monitoring further enhancements are not considered for IoT NTN in rel-17.
* The serving cell ephemeris information (used for L1 pre-compensation) is signalled in a new SIB, which is NTN-specific.
* Update to serving cell does not affect the system information value tag and does not trigger System information modification procedure. How to trigger re-read of this information is FFS. FFS if the UE shall reacquire the new SIB when SI update is triggered.
* Updates to serving cell ephemeris information are not bound to the BCCH modification period.
* Broadcast of the timing information on when a serving cell is going to stop serving the area is only applicable to quasi earth fixed cell (not to moving cell).
* It is feasible to use legacy barring bit to block legacy UEs, and it is possible to have a new bit that assumes the functionality of the old bit. It is FFS if it is needed to use the barring bit or whether other mechanism can be assumed (new band etc).

## RAN2#116bis-e

Agreements:

* It is up to UE implementation whether or when check SIB1 for TAC removal (for R17). Mobile UEs may need to check. No additional mechanism is needed. Can capture in a NOTE in Stage-2.
* We will have the barring bit to prevent terrestrial UEs to use NTN. FFS if we define a new barring bit for NTN UEs barring.
* When SI used for UL synch (pre-compensation) is no longer valid, the UE autonomously tunes away and re-acquires the required SI, and then comes back. FFS whether anything additional is needed.
* UE acquires the NTN specific SIB before accessing the cell.
* UE need to have a valid GNSS fix before going to connected. RAN2 assumes that the UE may need to re-acquire the GNSS fix right before establishing the connection (regardless if previously valid or not), if needed to avoid interruption during the connection.
* When the GNSS fix becomes outdated in RRC\_CONNECTED mode, the UE goes to IDLE mode.
* The contents of the ephemeris / assistance info for non-continuous coverage: Confirm that we Reuse the satellite ephemeris orbital parameters, already agreed for UL pre-compensation, for multiple satellite (Ref L1 params from R1)

## RAN2#117-e

Agreements:

* A new bit, e.g, cellBarred-NTN, is introduced in SIB1 to bar NTN UEs from accessing a NTN cell. FFS whether to consider MIB instead of SIB1 for NB-IoT. NTN UE ignores the legacy bit.
* SIBXX is an essential SIB, i.e the UE shall consider the cell barred if it is unable to acquire the SIB when scheduled.
* RAN2 will use a new SIB to share the ephemeris information for Discontinuous Coverage with the UEs. Sharing the information using dedicated RRC signalling is FFS.
* While Out of Coverage in Discontinuous Coverage deployment (in Idle Mode or PSM mode) the UE is not required to perform any cell search and may deactive its AS functions to optimize the power consumption. The remaining UE behaviour is left to UE implementation. FFS whether anything need to be specified for ASNAS interaction.
* RAN2 assumes that for discontinuous coverage, network can signal mean ephemeris parameters (for neighbours and potentially serving satellite for coverage prediction purpose), using the same (already introduced) ephemeris format. UE can always assume these are mean values and It is up to network implementation to derive mean value (and any trade-off between instantaneous and mean values if needed). FFS whether additional assumptions (like averaging time) need to be clarified, e.g to have predictable performance.
* Do not capture UE behaviour w.r.t to registration update in multiple tracking areas case in TS 36.304 section 5.4.
* P1: No further enhancement on cell reselection priority is needed in IoT-NTN.
* P3: For Prediction of discontinuous coverage, Information about satellite id, ephemeris type (FFS if two, three of four types) and epoch time will be provided with the ephemeris information. FFS if epoch time can be optional and be implicitly derived.