**3GPP TSG-RAN WG2 Meeting #113bis-e *R2-21xxxxxx***

**E-meeting, 12 April – 5 February 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.304** | **CR** | **draft** | **rev** | **-** | **Current version:** | **16.3.0** |  |
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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 | **X** | Core Network |  |

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|  |
| ***Title:***  | Running CR to 38.304 for NTN |
|  |  |
| ***Source to WG:*** |  ZTE Corporation, Sanechips, CMCC, Nokia |
| ***Source to TSG:*** | RAN2 |
|  |  |
| ***Work item code:*** | NR\_NTN\_solutions-Core |  | ***Date:*** | 2021-02-20 |
|  |  |  |  |  |
| ***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 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | This CR introduces the enhancements for idle and inactive mode procedures specified as part of the Work Item on Non-Terrestrial network in NR. |
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| ***Summary of change:*** | 1. Add definitions for Earth fixed cell, High Altitude Platform Station and Non-Terrestrial Network in section 3.1.
2. Add support for ephemeris based cell selection and reselection, provisioning of the information on when a cell is going to stop serving the area and/or the timing information (e.g. timer or absolute time) about new upcoming cell to assist cell selection and reselection in NTN and editor’s notes for the FFS part in section 5.2.1.
3. Add “*Editor’s note: For cell selection and reselection in or out of NTN, UE needs to be aware whether a cell is an NTN cell or not no later than SIB1 reception. Further details are FFS.*” in section 5.2.1.
4. Add “*Editor’s note: FFS on any further enhancement on cell reselection priority configuration in NTN*” in section 5.2.4.
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| ***Consequences if not approved:*** | Enhancements or idle and inactive mode procedures agreed as part of WI on Non-Terrestrial network in NR are not specified in TS38.304. |
|  |  |
| ***Clauses affected:*** | 3.1, 3.2, 4.1, 5.2.1, 5.2.4 |
|  |  |
|  | **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:*** |  |

Definitions, symbols 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 4.5.

**Allowed CAG list:** A per-PLMN list of CAG Identifiers the UE is allowed to access (see TS 23.501 [10])**.**

**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.

**CAG cell**: A cell broadcasting at least one Closed Access Group Identifier.

**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 Access Group Identifier**: Identifier of a CAG within a PLMN.

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

**Earth fixed cell:** A NTN cell fixed with respect to a certain location on the earth during a certain time duration. This can be provided by beam(s) continuously covering the same geographical areas all the time (e.g., the case of GEO satellites and HAPS) or by beam(s) covering one geographic area for a finite period and a different geographic area during another period (e.g., the case of NGEO satellites generating steerable beams).

**eCall Only Mode:** A UE configuration option that allows the UE to register at 5GC 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 [9].

**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.

**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.

**Network Identifier**: Identifier of an SNPN in combination with a PLMN ID (TS 23.501 [10]).

**Non-Public Network:** A network deployed for non-public use, as defined in TS 22.261 [12].

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [16], between two or more nearby UEs, using NR technology but not traversing any network node.

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

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

**Radio Access Technology:** Type of technology used for radio access, for instance NR or E-UTRA.

**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.

**Registered PLMN:** This is the PLMN on which certain Location Registration outcomes have occurred, as specified in TS 23.122 [9].

**Registered SNPN**: This is the SNPN on which certain Location Registration outcomes have occurred, as specified in TS 23.122 [9].

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

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

**Selected SNPN**: This is the SNPN 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 V2X sidelink communication defined in TS 23.287[16].

**SNPN Access Mode:** Mode of operation wherein UE only selects SNPNs (as defined in TS 23.501 [10]).

**SNPN identity**: An identifier of an SNPN comprising of a PLMN ID and an NID combination.

**Strongest cell:** The cell on a particular frequency that is considered strongest according to the layer 1 cell search procedure (TS 38.213 [4], TS 38.215 [11]).

**Suitable Cell:** This is a cell on which a UE may camp. For NR cell, the criteria are defined in clause 4.5, for E-UTRA cell in TS 36.304 [7].

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [17], between nearby UEs, using E-UTRA technology but not traversing any network node.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AS Access Stratum

CAG Closed Access Group

CAG-ID Closed Access Group Identifier

CMAS Commercial Mobile Alert System

CN Core Network

DCI Downlink Control Information

ETWS Earthquake and Tsunami Warning System

E-UTRA Evolved UMTS Terrestrial Radio Access

E-UTRAN Evolved UMTS Terrestrial Radio Access Network

HAPS High Altitude Platform Station

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

IMSI International Mobile Subscriber Identity

MCC Mobile Country Code

MICO Mobile Initiated Connection Only

NAS Non-Access Stratum

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NTN Non-Terrestrial Network

PLMN Public Land Mobile Network

RAT Radio Access Technology

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RRC Radio Resource Control

SNPN Stand-alone Non-Public Network

UAC Unified Access Control

UE User Equipment

UMTS Universal Mobile Telecommunications System

V2X Vehicle to Everything

4 General description of RRC\_IDLE state and RRC\_INACTIVE state

4.1 Overview

The RRC\_IDLE state and RRC\_INACTIVE state tasks can be subdivided into three processes:

- PLMN selection (for UE not operating in SNPN access mode) or SNPN selection (for UE operating in SNPN access mode);

- Cell selection and reselection;

- Location registration and RNA update.

PLMN selection, SNPN selection, cell reselection procedures, and location registration are common for both RRC\_IDLE state and RRC\_INACTIVE state. RNA update is only applicable for RRC\_INACTIVE state. When UE selects a new PLMN or SNPN, UE transitions from RRC\_INACTIVE to RRC\_IDLE, as specified in TS 24.501 [14].

When a UE is switched on, a public land mobile network (PLMN) or a SNPN is selected by NAS. For the selected PLMN/SNPN, associated RAT(s) may be set, as specified in TS 23.122 [9]. The NAS shall provide a list of equivalent PLMNs, if available, that the AS shall use for cell selection and cell reselection.

With cell selection, the UE searches for a suitable cell of the selected PLMN or selected SNPN, chooses that cell to provide available services, and monitors its control channel. This procedure is defined as "camping on the cell".

The UE shall, if necessary, then register its presence, by means of a NAS registration procedure, in the tracking area of the chosen cell. As an outcome of a successful Location Registration, the selected PLMN/SNPN then becomes the registered PLMN/SNPN, as specified in TS 23.122 [9].

If the UE finds a more suitable cell, according to the cell reselection criteria, it reselects onto that cell and camps on it. 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, an RNA update procedure is performed.

If necessary, the UE shall search for higher priority PLMNs at regular time intervals as described in TS 23.122 [9] and search for a suitable cell if another PLMN has been selected by NAS.

For UE not operating in SNPN access mode, search of available CAGs may be triggered by NAS to support manual CAG selection. The AS shall report available CAG-ID(s) together with their HRNN (if broadcast) and PLMN(s) to the NAS.

If the UE loses coverage of the registered PLMN/SNPN, either a new PLMN/SNPN is selected automatically (automatic mode), or an indication of available PLMNs/SNPNs is given to the user so that a manual selection can be performed (manual mode). As part of manual SNPN selection, the AS shall report available SNPN identifiers together with their HRNN (if broadcast) to the NAS.

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

The UE may perform NR sidelink communication and/or V2X sidelink communication while in-coverage or out-of-coverage for sidelink, as specified in clause 8.

The purpose of camping on a cell in RRC\_IDLE state and RRC\_INACTIVE state is fourfold:

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

b) When registered and if the UE wishes to establish an RRC connection or resume a suspended 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 network needs to send a message or deliver data to the registered UE, it knows (in most cases) the set of tracking areas (in RRC\_IDLE state) or RNA (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 the corresponding set of areas. The UE will then receive the paging message and can respond.

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

When the UE is in RRC\_IDLE state, upper layers may deactivate AS layer when MICO mode is activated as specified in TS 24.501 [14]. When MICO mode is activated, the AS configuration (e.g. priorities provided by dedicated signalling) is kept and all running timers continue to run but the UE need not perform any idle mode tasks. If a timer expires while MICO mode is activated it is up to the UE implementation whether it performs the corresponding action immediately or the latest when MICO mode is deactivated. When MICO mode is deactivated, the UE shall perform all idle mode tasks.

5.2 Cell selection and reselection

5.2.1 Introduction

UE shall perform measurements for cell selection and reselection purposes as specified in TS 38.133 [8].

When evaluating Srxlev and Squal of non-serving cells for reselection evaluation purposes, the UE shall use parameters provided by the serving cell and for the final check on cell selection criterion, the UE shall use parameters provided by the target cell for cell reselection.

The NAS can control the RAT(s) in which the cell selection should be performed, for instance by indicating RAT(s) associated with the selected PLMN, and by maintaining a list of forbidden registration area(s) and a list of equivalent PLMNs. The UE shall select a suitable cell based on RRC\_IDLE or RRC\_INACTIVE state measurements and cell selection criteria.

In order to expedite the cell selection process, stored information for several RATs, if available, may be used by the UE.

When camped on a cell, the UE shall regularly search for a better cell according to the cell reselection criteria. If a better cell is found, that cell is selected. The change of cell may imply a change of RAT. Details on performance requirements for cell reselection can be found in TS 38.133 [8].

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

For normal service, the UE shall camp on a suitable cell, monitor control channel(s) of that cell so that the UE can:

- receive system information from the PLMN or SNPN; and

- receive registration area information from the PLMN or SNPN, e.g., tracking area information; and

- receive other AS and NAS Information; and

- if registered:

- receive paging and notification messages from the PLMN or SNPN; and

- initiate transfer to Connected mode.

For cell selection in multi-beam operations, measurement quantity of a cell is up to UE implementation.

For cell reselection in multi-beam operations, including inter-RAT reselection from E-UTRA to NR, the measurement quantity of this cell is derived amongst the beams corresponding to the same cell based on SS/PBCH block as follows:

- if *nrofSS-BlocksToAverage* (*maxRS-IndexCellQual* in E-UTRA) is not configured in *SIB2/SIB4* (*SIB24* in E-UTRA); or

- if *absThreshSS-BlocksConsolidation* (*threshRS-Index* in E-UTRA)is not configured in *SIB2/SIB4* (*SIB24* in E-UTRA); or

- if the highest beam measurement quantity value is below or equal to *absThreshSS-BlocksConsolidation* (*threshRS-Index* in E-UTRA):

- derive a cell measurement quantity as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [11].

- else:

- derive a cell measurement quantity as the linear average of the power values of up to *nrofSS-BlocksToAverage* (*maxRS-IndexCellQual* in E-UTRA) of highest beam measurement quantity values above *absThreshSS-BlocksConsolidation* (*threshRS-Index* in E-UTRA).

Editor’s note: For cell selection and reselection in NTN, the satellite/HAPS ephemeris may be used by UE. The ephemeris is divided into serving cell’s ephemeris and neighbour cells’ ephemeris. FFS on the definition of satellite/HAPS ephemeris, under what circumstance UE will perform cell selection/reselection based on satellite/HAPS ephemeris and how would the serving cell’s ephemeris and neighbour cells’ ephemeris differ regarding e.g. the required accuracy or signalling impact.

Editor’s note: In NTN, provision of the information on when a cell is going to stop serving the area and/or the timing information about new upcoming cell is supported in Earth fixed cell. FFS if both of the information on when a cell is going to stop serving the area and/or the timing information about new coming cell are needed. FFS if such information is known from system information and/or the ephemeris. FFS on the utilization of such information.

Editor’s note: FFS whether UE location (and/or other information) based cell selection/reselection should be introduced for NTN.

Editor’s note: For intra-NTN and TN/NTN cell selection and reselection, UE needs to be aware whether a cell is an NTN cell or not no later than SIB1 reception. Further details are FFS..

5.2.4 Cell Reselection evaluation process

5.2.4.1 Reselection priorities handling

Absolute priorities of different NR frequencies or inter-RAT frequencies may be provided to the UE in the system information, in the *RRCRelease* message, or by inheriting from another RAT at inter-RAT cell (re)selection. In the case of system information, an NR frequency or inter-RAT frequency may be listed without providing a priority (i.e. the field *cellReselectionPriority* is absent for that frequency). If priorities are provided in dedicated signalling, the UE shall ignore all the priorities provided in system information. If UE is in *camped on any cell* state, UE shall only apply the priorities provided by system information from current cell, and the UE preserves priorities provided by dedicated signalling and *deprioritisationReq* received in *RRCRelease* unless specified otherwise. When the UE in camped normally state, has only dedicated priorities other than for the current frequency, the UE shall consider the current frequency to be the lowest priority frequency (i.e. lower than any of the network configured values). If the UE is configured to perform both NR sidelink communication and V2X sidelink communication, the UE may consider the frequency providing both NR sidelink communication configuration and V2X sidelink communication configuration to be the highest priority. If the UE is configured to perform NR sidelink communication and not perform V2X communication, the UE may consider the frequency providing NR sidelink communication configuration to be the highest priority. If the UE is configured to perform V2X sidelink communication and not perform NR sidelink communication, the UE may consider the frequency providing V2X sidelink communication configuration to be the highest priority.

NOTE 1: The frequency only providing the anchor frequency configuration should not be prioritized for V2X service during cell reselection, as specified in TS 38.331[3].

NOTE 2: When UE is configured to perform NR sidelink communication or V2X sidelink communication performs cell reselection, it may consider the frequencies providing the intra-carrier and inter-carrier configuration have equal priority in cell reselection.

NOTE 3: The prioritization among the frequencies which UE considers to be the highest priority frequency is left to UE implementation.

NOTE 4: The UE is configured to perform V2X sidelink communication or NR sidelink communication, if it has the capability and is authorized for the corresponding sidelink operation.

NOTE 5: When UE is configured to perform both NR sidelink communication and V2X sidelink communication, but cannot find a frequency which can provide both NR sidelink communication configuration and V2X sidelink communication configuration, UE may consider the frequency providing either NR sidelink communication configuration or V2X sidelink communication configuration to be the highest priority.

Editor’s note: FFS on any further enhancement on cell reselection priority configuration in NTN.

The UE shall only perform cell reselection evaluation for NR frequencies and inter-RAT frequencies that are given in system information and for which the UE has a priority provided.

In case UE receives *RRCRelease* with *deprioritisationReq*, UE shall consider current frequency and stored frequencies due to the previously received *RRCRelease* with *deprioritisationReq* or all the frequencies of NR to be the lowest priority frequency (i.e. lower than any of the network configured values) while T325 is running irrespective of camped RAT. The UE shall delete the stored deprioritisation request(s) when a PLMN selection or SNPN selection is performed on request by NAS (TS 23.122 [9]).

NOTE: UE should search for a higher priority layer for cell reselection as soon as possible after the change of priority. The minimum related performance requirements specified in TS 38.133 [8] are still applicable.

The UE shall delete priorities provided by dedicated signalling when:

- the UE enters a different RRC state; or

- the optional validity time of dedicated priorities (T320) expires; or

- the UE receives an *RRCRelease* message with the field *cellReselectionPriorities* absent; or

- a PLMN selection or SNPN selection is performed on request by NAS (TS 23.122 [9]).

NOTE 2: Equal priorities between RATs are not supported.

The UE shall not consider any black listed cells as candidate for cell reselection.

The UE shall consider only the white listed cells, if configured, as candidates for cell reselection.

The UE in RRC\_IDLE state shall inherit the priorities provided by dedicated signalling and the remaining validity time (i.e. T320 in NR and E-UTRA), if configured, at inter-RAT cell (re)selection.

NOTE 3: The network may assign dedicated cell reselection priorities for frequencies not configured by system information.

# Annex – Agreements for idle/inactive mode in NTN

## RAN2#111e

Agreements:

1. Cell selection / reselection in NR is the baseline in NTN idle mode procedure.
2. Satellite/HAPS ephemeris based cell selection and reselection should be defined for NTN (FFS what the term satellite/HAPS ephemeris actually means). FFS when this ephemeris based cell selection / reselection can be used. FFS whether UE location (and/or other information) based cell selection and reselection should be introduced for NTN
3. The satellite ephemeris should be provided to UE, at least for Satellite/HAPS ephemeris based cell selection and reselection (FFS what the term satellite/HAPS ephemeris actually means).
4. The network type (i.e. TN or NTN) should be known to UE. FFS whether to achieve this in an implicit or explicit way.
5. The existing cell reselection priority configuration can be taken as a baseline in NTN. FFS on any further enhancement.
6. Postpone the discussion on whether to introduce a new SIB until we have more progress on the content of NTN specific system information.

## RAN2#112e

Agreements:

1. Existing cell reselection principles are considered as baseline and that information about when a cell is going to stop serving the area and information about new upcoming cell can be further considered. In which form and how this is exactly implemented in the cell reselection principles is FFS.

## RAN2#113e

Agreements:

1. In NTN, the UE determines the TA based on the broadcast information (the use of other information is not excluded). In any case RAN2 will not go in a different direction than other groups
2. In NTN, the network may broadcast more than one TACs per PLMN in a cell, which is to up to network implementation.
3. The NTN ephemeris is divided into serving cell’s ephemeris and neighbour’s ephemeris. FFS how would they differ regarding e.g. the required accuracy or signalling impact.
4. Consider pre-configuration in uSIM, NAS, SIB and RRC signalling for providing the NTN ephemeris. Further discussion depends on the agreed ephemeris contents.
5. RAN2 thinks that a UE needs to know whether the network is a TN or NTN no later than SIB1 reception
6. The information on when a cell is going to stop serving the area and/or the timing information (e.g. timer or absolute time) about new upcoming cell is supported at least in Earth-fixed NTN scenario. FFS if both types of information are needed. FFS if this is known from system information and/or the ephemeris.