**3GPP TSG-RAN WG2 Meeting #115-e *R2-210xxxx***

**E-meeting, 9th - 27th August 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **36.304** | **CR** | **draft** | **rev** | **-** | **Current version:** | **16.4.0** |  |
|  |
| *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:***  | Idle mode 36304 Running CR for IoT NTN |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | RAN2 |
|  |  |
| ***Work item code:*** | LTE\_NBIOT\_eMTC\_NTN |  | ***Date:*** | 2021-09-09 |
|  |  |  |  |  |
| ***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)* |
|  |  |
| ***Reason for change:*** | Introduction of NTN in idle mode for NB-IoT and eMTC connected to EPC |
|  |  |
| ***Summary of change:*** | This running CR captures agreements for support of NTN in NB-IoT and eMTC from up to RAN2#115-e.  |
|  |  |
| ***Consequences if not approved:*** | NTN is not supported for NB-IoT and eMTC.  |
|  |  |
| ***Clauses affected:*** | 3.1, 3.3, 4.1, 5.2.1, 5.4 |
|  |  |
|  | **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:*** |  |

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.

**Discontinuous coverage:** definition FFS.

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

**Earth moving cell:** An NTN cell with respect to continuously moving geographic area on the earth. This can be provisioned by beam(s) which foot print slides over the Earth surface (e.g., the case of NGSO satellites generating fixed or non-steerable beams).

**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:** definition FFS.

**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.

**Quasi-earth fixed cell:** An NTN cell fixed with respect to a certain geographic area on the earth during a certain time duration. This can be provided by beam(s) covering one geographic area for a finite period and a different geographic area during another period (e.g., the case of NGSO satellites generating steerable beams).

**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.

Editor’s Note: The editor will keep some of the definitions FFS until stage 2 has defined them and when it is clear that the definitions will be needed for the idle mode procedures.

## 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.

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.

Editor’s Note: *Agreement*: Satellite 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. *Editor*: The note will be here until is clear on the impact of this agreement to idle mode procedures.

 Editor’s Note: *Agreement*: 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.

Editor’s Note: *Agreement*: 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.

End of change

Start of change

# 5 Process and procedure descriptions

## 5.1 PLMN selection

In the UE, the AS shall report available PLMNs to the NAS on request from the NAS or autonomously. For E-UTRA, if UE supports E-UTRA connected to 5GC, the AS shall also report CN type associated with the PLMN to NAS.

During PLMN selection, based on the list of PLMN identities in priority order, the particular PLMN may be selected either automatically or manually. Each PLMN in the list of PLMN identities is identified by a 'PLMN identity'. In the system information on the broadcast channel, the UE can receive one or multiple 'PLMN identity' (and, for E-UTRA, the CN type associated with the PLMN) in a given cell. The result of the PLMN selection performed by NAS (see TS 23.122 [5]) is an identifier of the selected PLMN.

### 5.1.1 Void

### 5.1.2 Support for PLMN selection

#### 5.1.2.1 General

On request of the NAS the AS shall perform a search for available PLMNs and report them to NAS.

#### 5.1.2.2 E-UTRA and NB-IoT case

The UE shall scan all RF channels in the E-UTRA bands according to its capabilities to find available PLMNs. On each carrier, the UE shall search for the strongest cell and read its system information, in order to find out which PLMN(s) the cell belongs to. If the UE can read one or several PLMN identities in the strongest cell, each found PLMN (see the PLMN reading in TS 36.331 [3]) shall be reported to the NAS as a high quality PLMN (but without the RSRP value), provided that the following high quality criterion is fulfilled:

1. For an E-UTRAN and NB-IoT cell, the measured RSRP value shall be greater than or equal to -110 dBm.

Found PLMNs that do not satisfy the high quality criterion, but for which the UE has been able to read the PLMN identities are reported to the NAS together with the RSRP value. The quality measure reported by the UE to NAS shall be the same for each PLMN found in one cell.

For each found PLMN, if the UE supports E-UTRA connected to 5GC, the associated CN type(s) shall also be reported to the NAS.

If the cell is barred for connectivity to EPC (as indicated by the *cellBarred*/cellBarred-CRS flag being set to the value barred, see clause 5.3.1) a UE supporting E-UTRA connected to 5GC shall only report the available 5GC PLMNs to NAS.

The search for PLMNs may be stopped on request of the NAS. The UE may optimise PLMN search by using stored information e.g. carrier frequencies and optionally also information on cell parameters from previously received measurement control information elements.

Once the UE has selected a PLMN, the cell selection procedure shall be performed in order to select a suitable cell of that PLMN to camp on.

If a CSG ID is provided by NAS as part of PLMN selection, the UE shall search for an acceptable or suitable cell belonging to the provided CSG ID to camp on. When the UE is no longer camped on a cell with the provided CSG ID, AS shall inform NAS.

#### 5.1.2.3 UTRA case

Support for PLMN selection in UTRA is described in TS 25.304 [8].

#### 5.1.2.4 GSM case

Support for PLMN selection in GERAN is described in TS 43.022 [9].

#### 5.1.2.5 CDMA2000 case

For CDMA2000 the network determination for HRPD and 1xRTT is described in [17] and [18] respectively.

#### 5.1.2.6 NR case

Support for PLMN selection in NR is described in TS 38.304 [38].

## 5.2 Cell selection and reselection

### 5.2.1 Introduction

UE shall perform measurements for cell selection and reselection purposes as specified in TS 36.133 [10].

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 idle mode measurements and cell selection criteria.

In order to speed up the cell selection process, stored information for several RATs may be available in 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, or if the current and selected cell are both E-UTRA cells, a change of the CN type. Details on performance requirements for cell reselection can be found in TS 36.133 [10].

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

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

- Receive system information from the PLMN; and

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

- receive other AS and NAS Information; and

- if registered:

- receive paging and notification messages from the PLMN; and

- initiate transfer to connected mode.

Editor’s Note: *Agreement*: RAN2 assumes satellite assistance info, e.g., for cell selection reselection, for serving cell is provided to UE. *Editor*: FFS whether idle mode behavious is needed to be captured.

Editor’s Note: *Agreement*: FFS is Satellite assistance information for neighbor cell(s) is provided to EU for cell selection/reselection (justification would be needed). *Editor*: FFS whether idle mode behaviour is needed to be captured.

Editor’s Note: *Agreement*: 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. *Editor*: The note will be kept here until it is clear on the impact of this agreement to idle mode procedures.

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].

Editor’s Note: *Agreement*: The UE determines the tracking area based on broadcast information (the use of other information is not excluded). *Editor*: This note will be kept here for now is is clear how/if there are anything to be changed in this section.

Editor’s Note: *Agreement*: When the network stops broadcasting a TAC, the UE needs to know it. FFS how this is done. *Editor*: This note will be kept here for now until it is clear how/if there are anything to be changed in this section.

 Editor’s Note: *Agreement*: UE does not do TAU if one of the currently broadcasted TAC belongs to the UE’s registration area.

Editor’s Note: *Agreement*: The network may broadcast more than one TAC per PLMN in a cell, which is up to network implementation.

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).
* Satellite 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)