

# Discussion on Handling of Forbidden TAI(s) within Broadcast TACs in Registration Procedure

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# Use Case 1 \*

*\* Use case 1 has been discussed in the CT1 Conference Call on Feb. 7th, 2022.  
Comments received there have been taken in account to a feasible extent in this document.*

## Pre-conditions:

UE has a Registration Area (TAI#1, TAI#2, TAI#3) which is the list of TAIs received during the last successful registration procedure. UE does not have any service area restrictions (neither allowed area nor non-allowed area exists) or forbidden area list stored.

1. Satellite NG-RAN broadcasts: TAC#4, TAC#5 and TAC#6;
2. UE selects TAC#4 by implementation according to CR C1-220709 (bullet b) of clause 4.23.x) (not-yet-agreed), builds up TAI#4 and considers TAI#4 as the current TAI (*i.e., the current TAI considered by UE/NAS*);
3. UE initiates an MRU towards AMF;
4. gNB sends the list of broadcast TAC#4, TAC#5 and TAC#6 (according to CR S2-2109097) and also reports TAC#5 as *the current TAI considered by gNB* to the AMF;

NOTE: Since the UE/NAS performs the selection of a TAI from the broadcast multiple TACs and the result is unknown to the UE/AS, the gNB is unable to provide the current TAI considered by the UE/NAS to the AMF. On the contrary, the gNB provides, based on its best knowledge of the UE location, the TAI in which the UE is currently located. Assume that the gNB reports TAC#5 as *the current TAI considered by gNB* to the AMF in this example. This leads to a mismatch between *the current TAI considered by UE/NAS* and *the current TAI considered by gNB*.

5. AMF checks with HSS/UDM and is informed that the UE is forbidden to be operated in TAC#4 and TAC#5, but TAC#6 is non-forbidden.

# Considerations

SA2 requirements on AMF (S2-2109097): *The AMF rejects the UE from accessing the network if the only received TAI is forbidden or if all received TAIs are forbidden based on subscription data.*

According to this AMF requirement, if a list of multiple TACs is in use, the AMF only rejects the UE if all received TAIs are forbidden. For the use case described in the previous slide (step 5), the AMF needs to accept the UE because TAC#6 is non-forbidden, although TAC#4+TAC#5 are forbidden.

If the AMF does not indicate which TAI is non-forbidden and which TAI is forbidden to the UE in the REGISTRATION ACCEPT message, none of the broadcast TAIs will be deemed forbidden and TAI#4 will be deemed the last visited registered TAI as per existing specifications. In short, the issues are:

- 1. The UE has no knowledge of which TAI needs to be stored in the forbidden list and which TAI is non-forbidden and;*
- 2. The UE cannot correctly determine the last visited registered TAI after receiving the REGISTRATION ACCEPT message.*

This would lead to the UE initiating registration procedure from a TAI deemed as forbidden by the network. Additionally, the UE would report to the network the last visited registered TAI deemed as forbidden by the network. Such UE behaviour is not in accordance with the existing CT1 specifications, and the subsequent network behaviour in this case is not specified whatsoever. Therefore, concerns are that the existing network operation might be broken, and the services and user experience would be affected.

## Proposal (Network)

1. If the AMF received the broadcast TAIs from the NG-RAN as described in 3GPP TS 23.501, the AMF shall include the current TAI considered by NG-RAN which is not forbidden as per user's subscription data in the REGISTRATION ACCEPT message.

NOTE: The current TAI considered by NG-RAN IE contains the TAI which is included in the User Location Information IE of the Initial UE Message as specified in 3GPP TS 38.413.

2. If the TAI(s) is forbidden as per user's subscription data and is also part of the list of broadcast TAIs from the NG-RAN as described in 3GPP TS 23.501, the AMF shall include the TAI(s) in the REGISTRATION ACCEPT message.

# Proposal (UE)

1. If the REGISTRATION ACCEPT message contains the current TAI considered by NG-RAN, the UE shall store the included TAI as the last visited registered TAI.

2. If the REGISTRATION ACCEPT message contains the forbidden TAI(s) of broadcast TAIs, the UE shall add the received TAI(s) in the list of "5GS forbidden tracking areas for roaming" and the list of "5GS forbidden tracking areas for regional provision of service".

# Use Case 2 \*

*\* Use case 2 was raised during the CT1 CC on Feb. 7<sup>th</sup>, 2022, i.e., what if, because of the movement of the satellite cell/beam into a different geographic area, before the ongoing registration procedure related to the primary list of TACs (e.g., TAC#4, TAC#5 and TAC#6) is completed, \*\* the satellite NG-RAN broadcasts a secondary list of TACs (e.g., TAC#x, TAC#y and TAC#z) which is received by the UE but not yet by the AMF?*

*\*\* The proposal of specifying a single extended NAS time by only taken the type of GEO into account in the other ongoing CT1 discussion would increase the probability of the occurrence of use case 2.*

Pre-conditions (same as described in use case 1):

UE has a Registration Area (TAI#1, TAI#2, TAI#3) which is the list of TAIs received during the last successful registration procedure. UE does not have any service area restrictions (neither allowed area nor non-allowed area exists) or forbidden area list stored.

1. Satellite NG-RAN broadcasts: TAC#4, TAC#5 and TAC#6 (**a primary list**);
2. UE selects TAC#4 by implementation according to CR C1-220709 (bullet b) of clause 4.23.x) (not-yet-agreed), builds up TAI#4 and considers TAI#4 as the current TAI (*i.e., the current TAI considered by UE/NAS*);
3. UE initiates an MRU towards AMF;
4. gNB sends the list of broadcast TAC#4, TAC#5 and TAC#6 (according to CR S2-2109097) and also reports TAC#5 as **the current TAI considered by gNB** to the AMF;
5. Satellite NG-RAN broadcasts **a secondary list** of TACs (TAC#x, TAC#y and TAC#z). Two sub-cases are shown below.
  - Sub-case a): No intersection between the primary list and the secondary list – the UE will initiate another registration procedure after decoding the secondary list. *This paper does not address this sub-case, given that the UE behaviour is covered by bullet h) of clause 5.5.1.27 of TS24.501.*
  - Sub-case b): Intersection between the primary list and the secondary list exists with e.g., a secondary list contains TAC#5, TAC#6 and TAC#7. The rest of this document focuses on this sub-case.
6. AMF (not being aware of the secondary list having been broadcast by the satellite NG-RAN) checks with HSS/UDM and is informed that TAC#5 and TAC#6 are forbidden, and TAC#4 are not forbidden.

## Considerations

Following the SA2 requirements on AMF (S2-2109097): *The AMF rejects the UE from accessing the network if the only received TAI is forbidden or if all received TAIs are forbidden based on subscription data.*

The AMF sends a REGISTRATION ACCEPT message to the UE. If no information about forbidden TAIs is sent together to the UE, the UE considers all TAIs (TAI#4, TAI#5 and TAI#6) of the primary list non-forbidden and then when it receives the TAIs (TAI#5, TAI#6 and TAI#7) of the secondary list, it will not initiate another registration procedure (because of an intersection between the primary list and the secondary list) until receiving the next broadcast list. *Consequently, the UE has a non-forbidden TAI#4 which is not in the secondary list.*

On the contrary, if the UE is informed about the forbidden TAIs (TAI#5 and TAI#6), the UE can initiate a registration procedure because of receiving TAI#7 of the secondary list.

Conclusion: The above analysis of use case 2 provides another evidence in support of the Proposals described under use case 1.