**3GPP T****SG-RAN WG2 Meeting #116-e draft-R2-21xxxxx**

**E-Meeting: November 1-12, 2021**

**Agenda item: 8.10.3.1**

**Source: Qualcomm Incorporated**

**Title: [AT116-e][109][NTN] LS to SA2 on the number of TACs**

**Document for: Discussion and Decision**

# Introduction

This document provides report of the following offline discussion.

* [AT116-e][109][NTN] LS to SA2 on the number of TACs (Qualcomm)

Initial scope: Discuss the possible content of an LS to SA2 to ask their view on the number of TACs to be broadcast in an NTN cell

Initial intended outcome: Draft reply LS.

Initial deadline (for companies' feedback): Tuesday 2021-11-09 1600 UTC

Initial deadline (for draft LS in R2-2111343): Tuesday 2021-11-09 2200 UTC

# Discussion

Following was agreed in the RAN2#114e meeting.

1. Change in TAC in SIB1 triggers SI update notification procedure as legacy behaviour. It is FFS whether broadcasting TAC update time can also be considered

As per agreement, when multiple TACs are broadcast per cell or per PLMN, network can send paging to UEs to notify the change of TACs (e.g., removal of a TAC from the broadcast list). It was FFS whether the TAC update time can also be considered, in other words, whether TAC update time or TAC validity time for each TAC in the list can also be considered.

[1] and [2] were briefly discussed during RAN2#116e meeting as provided below.

Proposal 1 : A validity timer associated to each TAI is broadcasted in the SI

Proposal 2 : UE uses the validity timer associated to the broadcasted TAC when selecting which TAC to update to NAS layer as well as when performing location update.

Proposal 3 : The validity timer associated to a broadcasted TAC can be described with 16 bits and support a timing accuracy of +/-100 ms.

- VC wonders how many TACs would typically be broadcast in an NTN cell. Ericsson thinks it's difficult to provide a number but this could be in the range of 2~4.

- QC thinks that we might need to wait for an SA2 decision on this.

* Postpone the discussion on how many TAC are broadcast pending feedback from SA2.
* Discuss offline the possible content of an LS to SA2 to ask their view on the number of TACs to be broadcast in an NTN cell
* Continue in offline 109

During this discussion, the issue of number of TACs that can be broadcast per cell or per PLMN was brought up. When there are many TACs broadcast, it is very likely that TAC changes happen frequently. This could lead to too frequent paging for SI update notification procedure, in which case, it may be more efficient to broadcast the TAC validity time instead of frequent paging.

Also [1] claims that the timing information associated to the TAC should be taken into account when more than one TAC is in UE’s registration area. This may also help to resolve the currently on-going controversial issue of selecting a TAC from multiple TACs among different working groups.

But it is also important to conclude first what is the limit on number of TACs that can be broadcast per PLMN in the cell. Currently in RRC running CR for NTN, this value is FFS.

PLMN-IdentityInfoList ::= SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-IdentityInfo

PLMN-IdentityInfo ::= SEQUENCE {

plmn-IdentityList SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-Identity,

trackingAreaCode TrackingAreaCode OPTIONAL, -- Need R

ranac RAN-AreaCode OPTIONAL, -- Need R

cellIdentity CellIdentity,

cellReservedForOperatorUse ENUMERATED {reserved, notReserved},

...,

[[

iab-Support-r16 ENUMERATED {true} OPTIONAL -- Need S

]],

[[

trackingAreaList-r17 SEQUENCE (SIZE (1..maxTAC)) OF TrackingAreaCode OPTIONAL -- Need R

]]

}

maxNrofPCI-Ranges INTEGER ::= 8 -- Maximum number of PCI ranges

maxPLMN INTEGER ::= 12 -- Maximum number of PLMNs broadcast and reported by UE at establisghment

maxTAC-r17 INTEGER ::= FFS -- Maximum number of Tracking Area Codes to which a cell belongs to

maxNrofCSI-RS-ResourcesRRM INTEGER ::= 96 -- Maximum number of CSI-RS resources per cell for an RRM measurement object

1. Do you agree to send LS to SA2 and ask their view on the number of TACs to be broadcast in an NTN cell? Also indicate if any other working group needs to be asked.

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| --- | --- | --- |
| Company name | Yes/No | Comments |
| OPPO | Yes |  |
| Intel | Yes | The root cause is tracking area is fixed, and current question is how large a tracking area could be. RAN3 should be in CC list as it may be also related to TAC selection issue at RAN side. |
| Thales | Yes | Typically the footprint of radio cells/beams will be typically up to hundreds of kilometres diameter for NR-NTN while it could be 10 times greater in the case of IoT-NTN.  Our understanding is that typical Tracking area in “terrestrial” cellular networks in rural area is hundreds of kilometres diameter. But they will be bounded per countries.  So a typical satellite beam (assuming typically up to 100 km diameter) could cover simultaneously a few tracking areas at a given time. When considering a region with several small countries, the standard should support up to 12 tracking areas per beam with several TACs per PLMN.  RAN2 could ask SA2 to confirm these assumptions.  Concerning the validity time associated to each TAC. We should distinguish between the following cases:   * GSO/Earth fixed cell: validity is permanent * NGSO/quasi Earth cell: validity of TAC is associated to the radio cell (typically few minutes) * NGSO/Earth moving cell: validity time will be typically few/tens of seconds. Given the high number of Hand-Over rate it requires, it is questionable that it is the most relevant scenario to be supported in the case of NR-NTN. |
| Apple | Yes | Should also include CT1 in cc. |
| Qualcomm | Yes | We are fine to include RAN3 and CT1. |
| Lenovo, Motorola Mobility | Yes | And we are OK to include RAN3 and CT1. |
| Xiaomi | Yes | We are fine to include RAN3 and CT1. |
| vivo | Yes | RAN3 and CT1 should also be included. |
| CATT | Yes | We are fine with RAN3 and CT1 as CC |
| Huawei, HiSilicon | Yes but | If the motivation is to determine the 4 options (regarding multiple TACs) listed by SA2, then we think based on the current progress in SA2, majority of companies in SA2 can accept Option D and Option D has the minimum spec impact on RAN, therefore Option D can be adopted.  If the motivation is to determine the maxTAC in ASN.1 design, we’re not sure whether SA2 can provide the answer since this is related to practical TA planning, and there is no such “typical value” in NR R15/R16. But we are ok with having an attempt. |
| Vodafone | yes | 1. RAN 2 should include their satellite beam width information in the LS. 2. This LS may be more critical/relevant for CT 1. At least CT 1 may need to consider this as they have a maximum number (16 ?) of TACs that they can send in the Registration Accept. |
| CMCC | Yes | It is reasonable to include RAN3 and CT1. |
| Ericsson | yes | Ok to add RAN3 and CT1 |
| Nokia | Not sure | As argued by Huawei, if the motivation is to obtain from SA2 the answer regarding how to set the maxTAC in ASN.1 then we doubt this LS makes sense.  Regarding the calculations provided by Thales, we wonder how the value 12 was obtained for the number of TACs an individual cell may need to broadcast? Do you assume there may be cases, where a single beam intersects with as many as 12 different TACs? Is it for the country-border case specifically? However, then those TACs can be divided using different PLMNs. And for a single PLMN Thales said ‘’several’’ should be enough, not 12…Thus, let’s further consider if 12 is really a reasonable value. |

1. If answer to Q1 is yes, please provide comments/suggestion/change on the draft LS? It is provided in the draft folder (copied here for your convenience).

RAN2 has discussed that if there are many TACs broadcast per PLMN in a cell for soft TAC update procedure, this may lead to very frequent system information change notification procedure to notify UE of change of TAC in a cell and TAC validity time can be provided to UE as a solution.

RAN2 would like to ask for feedback on maximum number of TACs that can be broadcast per PLMN in a cell.

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| Company name | Comments on the draft LS |
| OPPO | We only need to inform SA2 about the potential impact by broadcasting multiple TACs and should not mention any solutions which are not agreed by RAN2 yet. Therefore, we are not ok for the part of “and TAC validity time can be provided to UE as a solution” and this should be removed.  To help further RAN2 discussion, we may ask SA2’s opinion how often they see the broadcasted TACs will change over time. |
| Intel | We could ask SA2 how large a tracking area could be, or if there is a typical value. Then based on the knowledge of beam size, we can estimate how many tracking areas a NTN cell may cover.  We also agree with OPPO that no need to mention specific solution in this LS. |
| Thales | We suggest the following statement for the LS:  “*RAN2 has discussed the signalling of multiple TACs in the system information. In order to size this signalling, RAN2 would like to ask for feedback on the maximum number of TACs that can be broadcasted in a radio cell. Currently RAN2 assumes that up to 12 TACs from different PLMN can be broadcasted.*” |
| Apple | We agree with others that there is no need to talk about validity timer, especially since the solution is not yet agreed. We can say that RAN2 has agreed to initiate SI modification procedure for TAC change, and would like to know how large a tracking area can be, and how many TACs are expected to be broadcast. |
| Qualcomm | We are fine with what suggested by Thales.  But we prefer to also clarify that total TACs means (maxPLMN \* maxTAC-r17) unique TACs.  “*RAN2 has discussed the signalling of multiple TACs in the system information. In order to size this signalling, RAN2 would like to ask for feedback on the maximum number of TACs that can be broadcasted in a radio cell. Currently RAN2 assumes that depending on earth fixed TA size, up to 12 unique TACs from different PLMN can be broadcast in a cell.*” |
| Lenovo, Motorola Mobility | Agree with OPPO that no need to mention solutions without agreement. |
| Xiaomi | For the issue on the number of the TAC can be broadcasted, we think the root cause is we don’t know how the fixed TA is planned, So we can ask how to implement the fixed TA, such as the size the of the TA, the mapping information between fixed area and TA. With this information, RAN2 can estimate the number of TAC in one cell should be broadcasted. |
| vivo | Share same view with OPPO. |
| CATT | As OPPO’s comment, RAN2 only need to inform the impact without any solution. RAN2 has not agreed the TAC validity time and we suggest removing that.  It is better to ask SA2 about how large a tracking area could be. It is benefit for RAN2 getting how often the TACs changes. |
| Huawei, HiSilicon | The wording from Thales is ok. |
| Vodafone | 1. Traditionally, the size of a Tracking Area is determined by the paging channel capacity – so it would be useful to other groups if RAN 2 provided some indication on the paging capacity, or why the TA should be set smaller than this. In addition, RAN 2 should check that this type of satellite system has sufficient paging capacity… 2. The Qualcomm changes to the Thales text don’t seem quite right -> different PLMNs can use the same TAC. Also the text says that each PLMN can only have one TAC. I’d suggest something like:   *… Currently RAN2 assumes that depending on earth fixed TA size, up to 12 TACs from the same or different PLMN can be broadcast in a cell.*” |
| CMCC | The description of TAC validity time…part should not be included, which is still not agreed in RAN2. |
| Ericsson | Fine with the proposed wording |
| Nokia | We do not agree to state the following part: “*this may lead to very frequent system information change notification procedure to notify UE of change of TAC in a cell and TAC validity time can be provided to UE as a solution*.”, unless you have a solid justification and reference such was the RAN2 conclusion and clear need to address that in NTN WI was identified.  The wording from Thales is conditionally acceptable, but we think we should also (or instead) indicate how many TACs from the same PLMN are expected (it is still unclear how 12 was derived)  Overall, we think CATT has a point – we should try to get to know the expected size of TA, then we can derive how many TAs the beam may intersect with. |

1. If answer to Q1 is no, please elaborate your comment with reason. Also indicate which working group can decide this and what should be the value of maxTAC-r17?

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| --- | --- |
| Company name | Comments |
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# Conclusion

Fourteen companies provide comments, and twelve companies agree to send LS to SA2. Two companies raise doubts whether SA2 would be able to provide practical answer. Also, some companies asked the reasoning behind the assumption of 12 TACs per cell and probably it does not have to be mentioned.

It also seems a common understanding not to mention any issues related to TAC update, e.g., TAC validity time. Also, there is suggestion to ask the expected size of the earth fixed tracking area. Based on all the comments, rapporteur thinks following text for the LS can be agreeable.

*RAN2 has discussed the signalling of multiple tracking area codes (TACs) per PLMN in the system information. In order to size this signalling, RAN2 would like to ask for feedback on the maximum number of TACs from the same or different PLMN that can be broadcast in a radio cell and expected size of the earth-fixed tracking area.*

# Reference

[1] R2-2109587, “Validity timer of a broadcasted TAC”, THALES, Ericsson, RAN2#116e, November 1-12, 2021.

[2] R2-2109975, “Discussion on the remaining issue on TAC update”, vivo, RAN2#116e, November 1-12, 2021.