3GPP TSG-RAN WG2 Meeting #115-e Tdoc R2- 210XXXX

Electronic Meeting, Aug 16th - 27th, 2021

Agenda Item: 9.2.4.1

Source: Ericsson

Title: Summary of AI 9.2.4.1 “TA and Mobility related” (Ericsson) - Ph2

Document for: Discussion, Decision

# 1 Introduction

In RAN#86, a SI was approved to determine and evaluate the minimum necessary specification updates to introduce NB-IoT/eMTC support for non-terrestrial networks (NTN), The description for the SI was updated in RAN#90 **错误!未找到引用源。** and it was agreed to use the existing work on NR NTN captured in TR 38.821 **错误!未找到引用源。** as a baseline. In RAN#92-e, a follow up WI was approved to specify NB-IoT/eMTC support for Non-Terrestrial Networks.

In R2-2109003, we summarized the contributions, submitted to the AI 9.2.4.1, on tracking area update and mobility mechanisms for NB-IoT and LTE-M devices in NTN. That document has been treated during the online session and a set of agreements have been made.

This document is to continue the discussion based on what has been agreed during the online session and rapporteur’s suggestions per topic on which proposals to continue the discussion with as given below:

**Idle mode mobility**

**Proposal 3**         Discuss whether satellite assistance information, e.g., ephemeris, for neighbour cell(s) is provided to UE.

**Proposal 7**          Discuss whether cell selection procedure is used instead of cell reselection procedure when a UE is configured with an eDRX cycle.

**Tracking area update**

**Proposal 16**       Discuss whether system information modification notification procedure is used to inform TAC updates and, if not, discuss the alternative mechanisms.

**Connected mode mobility**

**Proposal 23**       Discuss whether value range for parameter t304 needs to be extended. The values to be specified, if necessary, are FFS.

**Proposal 19**       Discuss whether RAN2 should check with RAN4 on the RRM impacts for supporting CHO and related measurements for LTE-M.

**Proposal 27**       Discuss whether UE specific timers and constants for RLF and RRC connection re-establishment procedure require any changes.

# 2 Discussion

### 2.1 Idle mode mobility

In RAN2#113-e, the following agreement was made: “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.” Proposal 3, above, was briefly discussed, via emails, during Ph1, but some companies commented that it is not clear what such information, i.e., satellite assistance information, would be beneficial for at this point. Rapporteur thinks the intention is to have a similar agreement as in NR NTN and satellite assistance information for neighbour cells, in-line with what is to be provided for the serving cell, can be used for example to decide when to perform measurement on neighbour cells. Satellite assistance information for a neighbour cell can be subject of a discussion on whether it would be beneficial for estimating discontinuous coverage, but rapporteur thinks this is not within the context of this offline discussion. With the question below rapporteur would like to check if a reformulated version of **Proposal 3** above reflecting the intention better is acceptable to companies.

**Question 1: Do you think RAN2 should assume that satellite assistance information for neighbour cell(s) is provided to UE for cell selection/reselection?**

**Please note the following agreement for the serving cell “RAN2 assumes that satellite assistance information, e.g., for cell selection reselection, for serving cell is provided to UE” and that discontinuous coverage is not within the context of this discussion.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | No | Given the limited TU budget for this WI in R-17, we don’t think such optimizations are essential in the first release. We can consider it in Rel-18. |
| Lenovo | No | For continuous coverage we see no urgent necessity to introduce new mechanism for idle mode mobility. |
| Qualcomm | Maybe | Unless UE is provided information that which neighbor cells are out-going (no need to search) and which are good to search, neighbor satellite information can be useful. |
| Huawei, HiSilicon | No | This would be an optimisation and not critical for Rel-17 |
| CATT | No | It is unnecessary to introduce this mechanism in Rel-17. |
| OPPO | Yes | Similar to NR NTN, the timing information on when a cell is going to stop serving the area as well as the timing information on when a cell is going to start serving the area are needed to assist cell reselection in IoT NTN for earth fixed scenario and can be used to decide when to perform measurement on neighbor cells. |
| Xiaomi | No | We can discuss it later when the ephemeris data is decided. |
| Nokia | May be | For continuous coverage scenario this may be beneficial in selecting neighbor cells/frequency during cell reselection procedure. |
| ZTE | Yes | For IoT UEs under continuous coverage of satellites, even they are stationary, they will also see frequent changes of the serving/neighbor cells caused by satellite movement.  Therefore, with reference to the agreements in NR-NTN:   * On one hand, if UE can be aware of that the serving cell is going to stop serving the area, UE needs to stop measurement for this cell to avoid unnecessary measurement and start measurement on other cells as quickly as possible in order to try to find a new cell to camp on to avoid paging missing. * On the other hand, if UE can also be aware of that a neighbor cell is going to stop serving the area, UE can also stop the measurement for this cell to avoid unnecessary measurement and save power. |
| Ericsson | Maybe | Information that would make it possible/efficient for the UE to estimate when a cell is going to start/stop serving an area can be beneficial, but it can be considered in future releases due to the limited time left for Rel-17. |
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**Question 2: Do you think cell selection procedure should be used instead of cell reselection procedure when a UE is configured with an eDRX cycle?**

**If yes, please indicate whether the statement above should apply to any eDRX cycle or eDRX cycles with lengths above certain values.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | Yes | The eDRX cycle length does not matter, as the UE will know from the serving cell ephemeris whether it is going to be served by the same cell, when it wakes up. Based on this information the UE can decide whether to perform cell selection or not. |
| Lenovo | Yes with comments | If ephemeris is provided, UE can predict which cell will be serving when it wakes up. Cell selection can be used to replace reselection or not depending on the result.  So it could be “cell selection procedure **can** be used instead of cell reselection procedure…”. |
| Question | No | This is not clear what would be impact of this in specification. |
| Huawei, HiSilicon | No | We are also not clear what would be the impact on the specification. In general, already today, the UE performs cell selection when it wakes up and its serving cell is no longer there. |
| CATT | Yes | If UE is configured with eDRX cycle, the UE may already move into a new cell’s coverage when it wakes up, hence it had better perform cell selection instead of cell reselection. |
| OPPO | No | It is not clear what the spec impact is. |
| Xiaomi | No | UE can decide to perform cell selection or cell reselection based on UE implementation. |
| Nokia | Yes but | For stationary UE in moving cell scenario this will be beneficial depending on the eDRX cycle and serving cell coverage. If the PTW occasions exactly matches to the availability of same serving cell, directly attempting cell search instead serving cell measurements will be redundant. UE should be allowed for such option. But how the use this option for different cases can be left to UE implementation. |
| ZTE | Yes | In IoT over NTN, for the UE configured with eDRX cycle, the serving cell and the neighbor cells in an eDRX cycle may already stop serving this area in the subsequent eDRX cycle. As a result, when UE wakes up, UE has to select to a new cell that hasn’t been detected, e.g., UE needs to perform brand new measurement in each eDRX cycle.  As we assume the UE configured with eDRX is still in *Camped* *Normally* state when it’s out of PTW, we assume UE should perform cell reselection in next eDRX cycle. At least the specification may have ambiguity on this.  Therefore, we still suggest to clarify that cell selection should be used for this scenario in order to enable UE find and camp on a cell as soon as possible. |
| Ericsson | No | It may be beneficial if the UE performs cell selection first before checking whether serving cell is still available when UE happens to know that the serving cell is no longer there anymore. This can be up to UE implementation. In case, this has specification impact we can come back to this discussion if gain is justified. |
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### 2.2 Tracking area update

In RAN2#114-e, the following agreement was made for NR-NTN: “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” In Ph1, rapporteur stated that one company [13] proposed using the legacy system information update notification mechanism to inform about the TAC update whereas three companies, [7] [8] [17], proposed not to use that procedure due to its impact on UE power consumption.

**Question 3: Do you think system information modification notification procedure should be used to inform TAC updates?**

**Please state the rationale for your reply regardless of whether you replied yes/no considering the arguments provided in the references given above.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | No | This is not essential and should be avoided as there is a chance of higher power consumption. If the UE changes its tracking area, it will anyway issue a TAU on cell reselection. |
| Lenovo | No | TAU mechanism is sufficient for now. |
| Qualcomm | No | Paging resource cannot be used for this purpose in LTE. |
| Huawei, HiSilicon | No | We do not think it can work in NB-IoT considering the large BCCH modification period (minimum 40.96 s). We also agree with Mediatek that TAU will solve any problem. |
| CATT | No | It can based on the legacy TAU mechanism. |
| OPPO | Yes | We can reuse the conclusion in NR NTN. It is not clear to us why above companies stated that the legacy TAU procedure is sufficient to handle this. We understand that for triggering TAU, UE needs to know the TAC broadcasted by the NW has been updated. Then how can UE initiate TAU if NW does not notify the TAC change to the UEs? |
| Xiaomi | Yes, but | If other companies think the system information notification procedure is not suitable，we can go along with the majority. |
| Nokia | No with additional comments | Use of paging for such regular system information update from cell which is crossing should be avoided. For stationary UE this update will redundant as its TAC is not affected finally. The TAU based on cell reselection when UE see new TAC is sufficient. Skipping the system information update completely on TAC changes may impact the mobile UE which may miss the TAC change and will not trigger TAU |
| ZTE | No | Agree with Qualcomm and also agree above that TAU mechanism is sufficient. |
| Ericsson | No | Further discussion is required whether TAU mechanism is sufficient considering the discussion in NR NTN. Even though this may be the case in most of the scenarios, alternatives, that do not necessarily have specification impact, may be considered for the rest. |
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In [8] and [17] alternative mechanisms have been proposed to inform TAC updates.

**Question 4: If RAN2 agrees that system information modification notification procedure should NOT be used to inform TAC updates; do you think time information about TAC updates should be broadcast?**

**Please consider the mechanism proposed in [8] on a high level when you reply. Note that the details may be discussed separately, if needed, depending on the support.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | No | We think such optimizations can be done in later releases, after a working solution is made. If the UE changes its tracking area, it will anyway issue a TAU on cell reselection. |
| Lenovo | No | TAU mechanism is sufficient for now. |
| Qualcomm | Yes | This is agreement:   * When the network stops broadcasting a TAC, the UE needs to know it. FFS how this is done.   There should be some mechanism other than paging for UE to know when network stops this (doing nothing is not agreement).  eMTC and NB-IoT UEs support H-SFN, UTC time information is not the talk of this question. |
| Huawei, HiSilicon | No | TAU is sufficient |
| CATT | No | Same view as Lenovo. |
| OPPO | No | Same as NR-NTN, this can be handled by SI modification procedure. |
| Xiaomi | No | Maybe the existing TAU is sufficient. |
| Nokia | No | Even if time is introduced the idle mode UE should know the timer value from system information. It needs to system information change when the timer is included in system information or new TAC is added. Also how the timer will be used for triggering moment of TAU is not clear. So it cannot be agreed without finer details on the solution. |
| ZTE | No | We agree with above that TAU mechanism is sufficient. |
| Ericsson | Maybe | Please see our comment for the previous question. |
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**Question 5: If RAN2 agrees that system information modification notification procedure should be used to inform TAC updates; do you think that UE should ignore the notification if it is for TAC update and the UE is “stationary”?**

**Please consider the mechanism proposed in [17] on a high level when you reply. Note that the details may be discussed separately, if needed, depending on the support.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | Yes | Stationary UEs can ignore the notifications and if the UE changes its tracking area, it will anyway issue a TAU on cell reselection. |
| Lenovo | Yes |  |
| Qualcomm | No (question not clear) | If there is no SI modification notification, then how does UE know it is for TAC update? Existing notification does not indication TAC update and we have not introduced any new one. |
| Huawei, HiSilicon | No (do not understand the question) | We assume the question is in the case RAN2 agrees that SI update notification procedure is used to inform TAC change, otherwise it does not make sense  First we do not think SI notification procedure should be used as per Q4. Then, we think it may not be possible for the UE to know that the paging is for SI update (e.g. in case there is a message paging and thus direct information indication cannot be used) |
| CATT | See comment | We are confused that “If system information modification notification procedure should not be used to inform TAC update”, why there is “notification for TAC update”? How to understand it? |
| OPPO | No | If there is no SI modification notification, which notification should UE ignore?  [updated comments] We think that UE should always follow the network indication/notification and whether to notify SI motification can be up to network implementation. Note that, not all IoT devices are stationary, and so far we don’t have any definition of what “stationary UE” is in RAN2 and we think RAN2 will not have time to introduce any criteria for defining “stationary”. |
| Xiaomi | Yes | It UE is stationary, it should assume the TAC broadcasted by network would not be changed. |
| Nokia |  | We understand “System information notification should not be used” as system information notification is not sent from network” ,In that case UE ignoring the notification does not come into picture. This question can be taken up later after we finalise on need for paging notification for system information change. |
| ZTE | See comment | We understand the question may be that, without notification, is there any issue if a “stationary” UE is not aware of TAC change? We think it’s no issue.  We tend to agree with Xiaomi that if UE is stationary, it can assume the TAC broadcasted by network would not be changed. Network implementation can guarantee this. |
| Ericsson | No | Even if the UE is stationary relying on TAU mechanism may not be sufficient in scenarios where earth moving cells, e.g., with hard switch, are considered. |
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### 2.3 Connected mode mobility

In [18], it was discussed whether value range for parameter *t304* needs to be extended. In Rel-13 an extended value, i.e., *ms10000-v1310* was introduced for UEs that support CE with the intention to cover cases where the UE is in enhanced coverage. Now that adaptation for NTN is specified, new values for this timer can be considered to compensate for propagation delay due to satellites

**Question 6: Do you think that value range for parameter *t304* needs to be extended to compensate for propagation delay due to satellites?**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | Yes | The value range can be increased to accommodate the NTN RTT for eMTC. |
| Lenovo | No | We think the current value range is sufficient to cover UE-eNB RTT. |
| Qualcomm | No | 10s seems sufficient. If it means other smaller values with different granularities, then please clarify. |
| CATT | No | 1000ms is sufficient. |
| OPPO | No | 10s is sufficient. |
| Xiaomi | No | The maximum value of T304 is 10000ms, which is sufficient and much larger than the RTT between UE and gNB. |
| Nokia | No |  |
| ZTE | Probably yes? | The previous t304 is used when UE supports CE. Here it seems all companies agree this value can also be used for IoT NTN. We also agree and think its value range is sufficient.  We are open to discuss whether a few more values (smaller ones?) can be introduced for t304 to adapt to different UE-eNB RTT values. |
| Ericsson | Yes | In Rel-13 an extended value, i.e., ms10000-v1310 was introduced and the motivation was to cover cases where the UE is in enhanced coverage, however only one value was specified since the parameter, i.e., t304, is mandatory and there was only one spare value left. There may be a need to introduce larger value(s), e.g., for the GEO case considering the long propagation delay, but this requires further discussion. On the other hand, it would be good introduce in between values for better granularity considering various NTN deployment scenarios. |
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In [10], it is proposed that RAN2 should check with RAN4 on the RRM impacts for supporting CHO and related measurements for LTE-M.

**Question 7: Do you think RAN2 should check with RAN4 on the RRM impacts for supporting CHO and related measurements for LTE-M?**

**Please state the rationale for your reply regardless of whether you replied yes/no considering the arguments provided in the reference given above.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | Yes | We think RAN4 should be involved for considering RRM impacts of supporting CHO. |
| Lenovo | Yes | RAN4 can be informed if necessary. |
| Qualcomm | Yes | RAN4 should also add LTE-M devices in the CHO section. |
| Huawei, HiSilicon | Yes | RAN4 should not only check the impact and feasibility but introduce the corresponding requirements for CE-Mode A and CE-ModeB if both modes are supported. |
| CATT | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Nokia | Yes | RAN4 should be involved for LTE-M. because the coverage levels of LTE-M UE even in CE-Mode-A and CE-Mode-B are different from legacy LTE-UE. In such conditions impacts of measurements for conditional execution such as accuracy and delay needs to be analyzed |
| ZTE | Yes |  |
| Ericsson | Yes | RAN4 should be informed to take the RRM impacts for supporting CHO into consideration. Note that RAN4 is not listed as one of the WGs responsible as stated in the WID for IoT NTN and they have no TU allocation in Rel-17. Although RAN4 may respond to RAN2 timely it is possible that requirements, if needed, may be introduced at a later stage. |
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During the online session, some companies indicated that more time is needed to check whether procedural update is required to support RLF and RRC connection re-establishment procedures in IoT NTN. Since there was no time to bring it up online, the rapporteur would like to check whether UE specific timers and constants for RLF and RRC connection re-establishment procedure require any changes, i.e., value range or behaviour, in IoT NTN.

**Question 8: Do you think that UE specific timers and constants for RLF and RRC connection re-establishment procedures require extended value range and/or new behaviour in IoT NTN?**

**Please state the rationale for your reply regardless of whether you replied yes/no and, if yes, provide the names of the timers and constants that you think which may require change.**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | - | We think such UE specific timers need to be identified first, before considering their extension. |
| Lenovo | Yes | The triggering and recovery of RLF may bring additional delay and power consumption in NTN due to LEO movement or link switch. For NB-IoT mobility a more straightforward way is to use the conditional concept as CHO for NR NTN, i.e. conditional RRC re-establishment.  This can be implemented by introducing a timer or indicating a time so that UE can initiate RRC reestablishment to target cell at a given time, instead of triggering RLF and attempting recovery. |
| Qualcomm | Maybe | Extension of timers can be done if identified necessary. Agree with MediaTek. |
| Huawei, HiSilcon | probably no | This should be discussed in a per timer basis and separately for NB-IoT and eMTC as the value ranges may be different.  In general, in NB-IoT, the timers can already be very large and likely to be sufficient.  We may need to check RRC Connection Re-establishment in discontinuous coverage, but this is probably not critical for Rel-17 |
| CATT | See comments | Agree with MediaTek, the timers should be identified first. |
| OPPO | - | Agree with MediaTek. |
| Xiaomi | Maybe | Agree with MediaTek, we should identify the UE specific timers and constants first.  If it is necessary, extended value range and/or new behavior can be considered. For different UE specific timers and constants, we need to discuss the issue separately. |
| Nokia | May be | Agree with QC and MediaTek. |
| ZTE | See comments | We think the motivation is also to address the new scenario in IoT NTN, e.g., even for a stationary UE, it may see frequent changes of the serving/neighbor cells caused by satellite movement (please note it’s different from discontinuous coverage case, in which it may be the case that no target cell is there after serving cell stop serving the area).  Firstly, we agree with Huawei that in NB-IoT, the timers related to RLF and RRC connection re-establishment are large enough. This is also the case for eMTC. In other word, we think the previous extension on these timers for enhanced coverage can adapt to the UE-eNB RTT in IoT over NTN. Anyway the details can be checked later, e.g., in stage-3.  Secondly, we see another issue. If the UE successfully establish or resume a RRC connection at the time that is close to the time that the serving cell is going to stop serving, due to the inadequate remaining satellite serving time, it’s highly possible that the data transmission couldn’t be finished as expected and UE has to continue the data transmission in the new cell.  In order to reduce the reestablishment RRC procedures or interrupted data transmission, it can be considered to defer the RRC connection establishment/resumption if it happens to occur when the time is close to the time that the serving cell is going to stop serving. In general, RRC establishment/resumption procedure is initially triggered from NAS layer. But the awareness of the time that the serving cell is going to stop serving may generally be based on SIB, e.g., in AS layer by RRC protocol. So the above deferring process may need some interaction between NAS and AS layer. |
| Ericsson | Less likely | But we agree that this should be discussed separately for NB-IoT and eMTC to check in case an update is needed. |
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# 3 Summary

TBD

# 3 Conclusion

This document is to continue the discussion based on what has been agreed during the online session and rapporteur’s suggestions per topic on which proposals to continue the discussion with. Based on the discussion in the section above the following proposals are made:

[Proposal 1 ???.](#_Toc80614972)

# References

1. [1] R2-2108328 Mobility enhancement for IoT-NTN NEC Telecom MODUS Ltd.
2. [2] R2-2107083 Discussion on CP impact for IoT over NTN OPPO
3. [3] R2-2107084 Discussion on idle mode procedures for IoT over NTN OPPO
4. [4] R2-2107321 Discussion on connected mode UE of IoT NTN CATT
5. [5] R2-2107322 Discussion on IDLE mode UE of IoT NTN CATT
6. [6] R2-2107371 Discussion on the issue of mobility for IoT over NTN Spreadtrum Communications
7. [7] R2-2107426 TA and mobility for IOT NTN Huawei, HiSilicon
8. [8] R2-2107562 TAC update procedure Qualcomm Incorporated
9. [9] R2-2107767 Mobility issues of IoT NTN ZTE Corporation, Sanechips
10. [10] R2-2107813 Analysis on mobility aspects for IoT-NTN Nokia, Nokia Shanghai Bell
11. [11] R2-2107916 Considerations on NB-IoT mobility for IoT NTN Lenovo, Motorola Mobility
12. [12] R2-2108018 Discussion on connected mode mobility for IoT NTN Xiaomi
13. [13] R2-2108172 Discussion on TA and idle mode mobility enhancement Xiaomi
14. [14] R2-2108338 On Cell Re-selection in IoT-NTN MediaTek Inc.
15. [15] R2-2108339 On Improving Tracking Area Updates in IoT NTN MediaTek Inc.
16. [16] R2-2108546 Enhanced RRC re-establishment for mobility in IoT-NTN CMCC
17. [17] R2-2108548 Discussion on TA Update for IoT-NTN CMCC
18. [18] R2-2108757 Mobility for NB-IoT and LTE-M in NTN Ericsson