**3GPP T****SG-RAN WG2 Meeting #122 R2-230xxxx**

**Incheon, Korea:** **May 22-26, 2023**

**Agenda item: 7.6.3.1**

**Source: MediaTek**

**Title: Report of [Post122][112][IoT NTN Enh] Mobility enhancements**

**Document for: Discussion and Decision**

# Introduction

RAN2 has discussed the IoT NTN Mobility enhancement in RAN2#122 meeting and made the following agreements:

Agreements:

1. Extend the neighbour cell information in existing SIBs (not SIB31) to include satellite ID
2. The system Information modification procedure is not triggered for an update of new SIB on neighbor-cell assistance information.
3. For NB-IoT, SIBxx is not an essential SIB. UE does not need to consider the cell barred if it is unable to acquire the SIB when scheduled. FFS for eMTC
4. In RRC IDLE, how to (re-)acquire neighbour cell assistance information is up to UE’s implementation.
5. The satellite ID in the new SIB is an integer of X bits wherein X depends on the maximum number of satellites to be considered for mobility.
6. The satellite ID is defined as Radio resource control information element to be used in other configurations.
7. If a parameter in the common TA parameters is absent, then the value of the parameter is assumed zero.
8. If Kmac is absent, then the value of Kmac for the neighbor satellite in the list is assumed zero. FFS on further optimization on signaling, e.g., signalling explicit value 0 of Kmac.

Agreements:

1. Reference location and distanceThresh in SIB31. A change of reference location does not trigger SI modification. A UE does not need to get a new reference location as long as ephemeris and Epoch time are valid (in Connected mode the UE relies on T317)

Agreements:

1. For earth-fixed cells, introduce t-ServiceStart for neighbor cells. If UE is aware of the t-ServiceStart of the neighbour cell then may be used (up to UE implementation) to determine when to start measurements of that neighbor cell
2. If the serving cell t-service expires, stop T310 (if running) and start T311 (i.e. perform cell search and re-establishment without attempting to recover on the current cell for the duration of T310). FFS on discontinuous coverage
3. The distance between the UE and a second reference location (e.g. within a neighbour cell) is not taken into account.
4. R18 location and time based trigger for measurements (for connected mode and for idle) apply to both NB-IoT and eMTC.

This post meeting discussion is to discuss the remaining issues related to neighbor cell/satellite information and triggers for neighbor cell measurements.

This document provides the report for the following email discussion.

**[Post122][112][IoT NTN Enh] Mobility enhancements (Mediatek)**

Scope: Discuss remaining issues related to SIB handling(i.e. for neighbor cell/satellite information and for triggers for neighbor cell measurements)

Intended outcome: Summary of the email discussion

**Deadline (for companies’ comments and responses): August  9th, 10:00 UTC**

**Deadline (for rapporteur’s report): August 10th 10:00 UTC**

# Discussion

**Neighbor cell information**

It has been agreed that for NB-IoT, SIBxx is not an essential SIB. UE does not need to consider the cell barred if it is unable to acquire the SIB when scheduled. FFS for eMTC.

**Q1: Do companies agree that for eMTC, the new SIB (SIBxx) is not an essential SIB. UE does not need to consider the cell barred if it is unable to acquire the SIB when scheduled?**

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| **Company** | **Agree/Disagree** | **Comments** |
| Huawei, HiSilicon | Agree | In R17, there is no SIBxx but the eMTC NTN UE can still access an NTN cell. We don’t see the need to bar an NTN cell without SIBxx for R18 UEs. |
| Apple | Agree |  |
| CATT | Agree |  |
| MediaTek | Agree |  |
| Qualcomm | Agree | Agree with Huawei.  In addition, for eMTC, we should consider the fact that the necessary information for connected mode measurement should be provided by network as part of measurement object configuration. In this case, mainly what network needs to care is the UE’s capability to support the feature. |
| ZTE | Agree |  |
| Lenovo | Agree |  |
| Samsung | Agree | Agree with others. We also want to state that with the SIBxx acquiry that we are discussing below, a UE can acquire the SIBxx in connected mode. |
| Xiaomi | Agree |  |
| Ericsson | Agree |  |
| Nokia | Agree |  |
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**Rapporteur Summary**

Proposal 7 from [offline-102] Mobility enhancements [1] gained the majority support (12/16). But it has not been discussed during the RAN2#122 online session due to limited time. Hence, Rapporteur would like to discuss this proposal again.

*Proposal 7 (12/16) RAN2 will not consider option (a) Cell stop time of neighbor cell in SIBxx.*

**Q2: Do companies agree that RAN2 will not consider cell stop time of neighbor cell in the new SIB (SIBxx)?**

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| **Company** | **Agree/Disagree** | **Comments** |
| Huawei, HiSilicon | Agree |  |
| Apple | Agree |  |
| CATT | Agree |  |
| MediaTek | Agree |  |
| Qualcomm | Agree |  |
| ZTE | Agree |  |
| Lenovo | Agree with comments | Adding “in this release” in case it is needed in future. |
| Samsung | Agree |  |
| Xiaomi | Agree |  |
| Ericsson | Agree |  |
| Nokia | Agree |  |
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**Rapporteur Summary**

Proposal 8 from [offline-102] Mobility enhancements [1] has gained the majority support (11/16).

*Proposal 8 (11/16) Cell start time of quasi-earth fixed neighbor cell is broadcast in SIBxx.*

The following agreement was made in the RAN2#122 after [offline-113] Measurements before RLF[3].

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| For earth-fixed cells, introduce t-ServiceStart for neighbor cells. If UE is aware of the t-ServiceStart of the neighbour cell then may be used (up to UE implementation) to determine when to start measurements of that neighbor cell |

In the 36.331 running CR[4], the t-ServiceStart for neighbor cells was put in the SIB3 and there is an FFS note: FFS whether t-ServiceStartNeigh is per neighbour cell. Per Rapporteur’s understanding, if the t-ServiceStart for neighbour cells is per neighbor cell, it should be introduced in SIBxx, otherwise, it should be in SIB3.

Because there was a majority support of t-ServiceStart in SIBxx, Rapporteur would like to ask the following question:

**Q3: Do companies agree that t-ServiceStart for quasi-earth fixed neighbor cells is per neighbor cell and is broadcast in the new SIB (SIBxx)?**

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| **Company** | **Agree/Disagree** | **Comments** |
| Huawei, HiSilicon | Disagree | From our perspective, the simplest way is to only have one *t-ServiceStartNeigh* which is the earliest time among all neighbour cells, and SIB3 is used to accommodate this information (considering *t-Service* is also in SIB3). |
| Apple | Agree | For neighbor cells, it is more reasonable to carry the t-ServiceStart in SIBxx. Regarding Huawei’s comment, our understanding is network should provide the t-ServiceStart per each frequency at least for UE to determine when to start the measurement on that frequency. Then it seems a bit strange to indicate the neighbor cell’s frequency info and t-ServiceStart in SIB3. |
| CATT | Agree | The t-ServiceStart for quasi-earth fixed neighbour cells should be per neighbour cell, this can avoid measurement on a given neighbour cell before the staring time of the neighbour cell. |
| MediaTek | See comments | Different neighbor cells should have different start time, therefore, the t-ServiceStart should be per neighbor cell.  However, it should be taken into account that it is possible that one satellite provides more than one cells. In this case, considering the new SIB is not a list of neighbor cells but a list of satellites, the t-ServiceStart list for intra-frequency neighbor cells should be introduced in SIB3 and t-ServiceStart list for inter-frequency neighbor cells should be introduced in SIB5. |
| Qualcomm | Agree | t-Service is cell stop time of service cell that is used for neighbor cell measurement trigger. So it is not same as cell start time of each neighbor cell.  We have not agreed that only the earliest time among all neighbor cells should be broadcast. Probably this should be discussed first. |
| ZTE | See comments | During RRC running CR review, we have the thoughts that this *t-ServiceStartNeigh* value is at least configured per neighbour satellite. Then SIBxx can be used to contain *t-ServiceStartNeigh* for each satellite. This further imply that all the neighbour cells belonging to the same satellite have same *t-ServiceStartNeigh*.  We think it’s also possible to configure *t-ServiceStartNeigh* per neighbour cell, then SIB4/SIB5 can be used (similar view as MediaTek but just think it’s suitable to use SIB4 for intra-frequency case, not SIB3?).  We slightly prefer the latter way. |
| Lenovo | Agree | t-ServiceStrat shall be cell-specific and can be included in SIBxx. |
| Samsung | Agree |  |
| Xiaomi | Agree |  |
| Ericsson | Agree |  |
| Nokia | Agree | T-Service time for each Target-cell is simple option. |
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**Rapporteur Summary**

Proposal 13 from [offline-102] Mobility enhancements [1] has gained the majority support (14/16). But it has not been discussed during the RAN2#122 online session due to limited time. Rapport would like to discuss this proposal again.

*Proposal 13 (14/16) If ephemeris is absent in a list in SIBxx, serving satellite ephemeris applies. FFS signalling details of other parameters such as validity duration.*

**Q4: Do companies agree that if ephemeris is absent in a list in the new SIB (SIBxx), serving satellite ephemeris applies?**

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| **Company** | **Agree/Disagree** | **Comments** |
| Huawei, HiSilicon | Postpone | One issue is that, if the ephemeris information reuses that of the serving cell, will the validity duration and epochTime also uses those of the serving cell? But whether SIBxx will have a separate validity duration and epochTime is still under discussion, so we think it’s a bit early to agree on this proposal. |
| Apple | Agree | Regarding Huawei’s comment, we think these info can be handled together. |
| CATT | Agree | Same view with Apple. |
| MediaTek | Agree | If the statement is true, (i.e., if the ephemeris is absent in SIBXX, serving satellite ephemeris applies.), it implies the satellite in the new SIB is the serving satellite.  It is possible that the serving satellite is providing intra/inter frequency neighbor cells. In this case, for this satellite entry of new SIB, only satellite ID is needed. Other satellite assistance information such as ephemeris can be absent and serving satellite assistance information in SIB31 can apply. |
| Qualcomm | See comments | Additional information like beam information of service satellite can be provided via SIBxx, i.e., with absence of ephemeris. However, the reference location and radius for serving satellite are now captured in SIB31 itself, then we also think we need to figure out the clear benefit of absence case.  It could be just defined that satellite ID = 0 belongs to serving satellite and satellite ID = 0 can be included in SIB 4. |
| ZTE | Agree with comments | Firstly, we cannot understand the above thoughts/comments “*it implies the satellite in the new SIB is the serving satellite*” or “*Additional information like beam information of service satellite can be provided via SIBxx, i.e., with absence of ephemeris*”. We don’t think this is the reasonable case and have no any previous discussion on the justification or intention for such thoughts.  Basically, SIBxx is just for accommodating the assistant information of neighbouring satellites.  We assume it’s possible for two satellites to have similar or same ephemeris information. The corresponding case may be that two different satellites are in the same location (cover the same area) at the different time points. In other word, NW can provide the ephemeris information of a neighbour satellite at a certain time point and it happens that this ephemeris information is the same as the ephemeris information of the service satellite at another time point. As a result, this ephemeris information of a neighbour satellite can be omitted from the SIBxx and ephemeris information of the service satellite could be applied. We think such delta configuration is feasible for NW and beneficial for reducing signalling overhead. But we think when providing such delta configuration for ephemeris information, it’s highly possible or should be that the epochTime still needs to be provided for this neighbor satellite, which cannot be same as the epochTime for ephemeris information of the service satellite (our answer to HW’s question).  We think it may be unreasonable that the ephemeris information and epochTime of a certain neighbour satellite are all same as those of serving satellite. That may means two satellites are always at the same places at any time. This may be not allowed. |
| Lenovo | Agree with comments | The ephemeris part (i.e. orbital or PVT parameters) of serving cell can be reused, while whether the epoch time and validity duration can be further discussed. |
| Samsung | See comments | The question itself is a bit outdated since the current SIBxx design only includes the neighbouring satellites.  Instead, we should explicitly signal in SIB4/SIB5 whether the frequency is related to the serving cell. This can for instance be signalled with a specific flag, or satelliteId=0 can be used as proposed by Qualcomm.  For Huawei’s concern, we do not think that there are any problems related to this. The ephemeris of neighbouring cells that originate from the same satellite as the serving cell would have the same validity duration and epoch time. |
| Xiaomi | Agree |  |
| Ericsson | Agree |  |
| Nokia | Agree | Ephemeris information is per neighbouring satellite. It is is linked to each neighbour cell via satellite-ID. If there intra-satellite neighbour-cell for serving satellite, missing field can indicate use serving cell ephemeris information. |
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**Rapporteur Summary**

Proposal 2 from [offline-102] Mobility enhancements – second round [2] has gained somewhat majority (9/13). During the online discussion, the consensus cannot be converged, and the discussion is postponed. Rapporteur would like to continue the discussion to find a way forward.

Proposal 2 Agree one of the options below

- (9/13) No validity duration introduced for SIBxx. It is up to UE implementation when to acquire SIBxx, for example, UE may assume validity duration of SIBxx is same as serving satellite or may rely on T318 in connected mode (i.e., of SIB31).

**Q5: Do companies agree that no validity duration introduced for SIBxx. It is up to UE implementation when to acquire the new SIB (SIBxx), for example, UE may assume validity duration of SIBxx is same as serving satellite or may rely on T318 in connected mode (i.e., of SIB31)?**

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| **Company** | **Agree/Disagree** | **Comments** |
| Huawei, HiSilicon | Disagree with no validity duration for SIBxx;  Agree with relying on T317/T318 to reacquire SIBxx together with SIB31. | We would like to clarify the use of validity duration and the expected UE behaviour separately.  We think the use of validity duration is to inform the UE at what time the neighbour cell ephemeris will become invalid, which is useful for UE to determine whether the neighbour cell measurements should be performed or stopped.  Regarding the UE behaviour of reacquiring the SIBxx, we think UE can also rely on T317 to re-acquire the SIBxx together with SIB31, which the advantage of reducing the complexity of system information acquisition. |
| Apple | See comment | We should avoid that UE has to trigger a SIBxx dedicated acquisition procedure based on its validity duration. This is not only to reduce interruption but also to save UE power consumption.  Thus, we prefer NW to bundle the two SIB(s) together in terms of validity and epochTime, to simplify the SIBxx acquisition. |
| CATT | See comment | Agree with Huawei that, we support the network can configure separate validity duration for SIBxx if the network wants, or the validity duration of SIB31 can be reused.  Agree with relying on T317/T318 to reacquire SIBxx together with SIB31. |
| MediaTek | See comments | If the new SIB has the same validity duration and the same validity start time (i.e., epoch time) as SIB31, it can simplify the UE behaviour of updating new SIB in RRC connected mode. UE can update the new SIB when acquiring the SIB31 when it is needed. RAN2 can specify that new SIB has the same validity duration and the same validity start time. |
| Qualcomm | Partly agree | The SIBxx should be non-essential compared to SIB31, therefore UE should not be required to acquire it in both IDLE and connected mode.  However, for those UEs who wants to keep the up-to-date SIBxx would need some information on validity when it is time to update it.  We should introduce validity duration for SIBxx. Neighbor satellite ephemeris validity duration should be longer than that of serving satellite’s. But anyway, there needs to be option that network may not broadcast it due to TBS size limitation which means we should define the absence scenario i.e., the SIB31 validity duration applies. |
| ZTE | Similar view as Huawei | Since legacy SI modification procedure would not be applied to SIBxx, we are fine to introduce validity duration for SIBxx. May we need to further discuss one or more validity duration(s)? |
| Lenovo | Agree with Huawei’s view. |  |
| Samsung | Partly agree with Huawei, see comments | First of all, we agree on relying on (T317)/T318 for re-acquiring SIBxx together with SIB31 in order to not make the procedures complicated both for the UE and the eNB scheduler. We cannot have it up to UE implementation, as the network needs to have some type of awareness of when UE tunes away to acquire SIBxx.  With regards to the following we are OK with having a single separate validity duration for SIBxx, but the validity duration for the SIBxx needs to be able to work in a slightly different manner compared to the one for SIB31. The SIBxx validity duration should indicate when the SIBxx validity duration is no longer valid and that the UE shall acquire SIBxx in the next T318 occasion. This allows for the SIBxx validity duration to be larger than the SIB31, which means that UE does not need to acquire SIBxx during every T318 occasion.  If no validity duration is present, then we are fine to use the SIB31 validity duration. This can also be useful option to make eNB scheduler more simple in that eNB knows when UE tunes away to read SIBxx.  Then when it comes to “epoch time”, this can be kept more simple compared to SIB31. For SIB31 the epochTime is used both to determine when the ephemeris element is valid and when the ephemeris elements should be started to be considered valid (i.e the start of T317). For neighbouring cell ephemeris, our understanding we only need to be concerned with the starting point of the validity duration.  The start of the validity duration of SIBxx we propose can either be same as that of SIB31 epochTime or be shifted by some configured time from the SIB31 epochTime. Alternatively it can be based on when the UE acquires SIBxx, as it does not need to be as exact as SIB31 epochTime. |
| Xiaomi | See comments | We agree with QC that validity duration should be provided for UE to determine when SIBXX is still valid.  But it doesn’t mean we need to specify the condition when UE should reacquire SIBxx. It can still be left to UE implementation. |
| Ericsson | See the comments | Agree that this should not be left up to UE implementation and that there is a need to have a validity duration for SIBxx. However, we prefer to keep it simple and suggest using the one for the serving cell or SIB31 instead of introducing yet another validity timer. |
| Nokia | See comments | The SIBXX carries additional information to improve the cell reselection in IDLE mode. As the UE may need to acquire this SIBXX only when it start cell reselection the usage of this information is one-time only in the serving cell. So we don’t see need for maintaining this validity in the same serving cell for another cell reselection.  It is upto UE implementation to acquire SIBXX prior to entering into connected state. Only in that case, to avoid re-acquiring this information prior to connected mode measurements UE need to check the validity timer. The UE may also decide to acquire new SIBXX prior to connected mode measurement. In that case validity timer is not needed. Moreover for connected mode measurements to have valid measurement prior to RLF declaration this SIBXX is not essential. The scope of new SIBXX is mainly to optimise cell-reselection measurements. In case of RLF UE will anyhow trigger cell-reselection and re-acquire SIB of best-cell. So acquiring SIB-XX for connected mode measurements can be optional.  Considering the above SIBXX related functionality at UE can work without the validity timer. The validity timer may optimise the connected mode measurements for certain UE implementations only.  Hence we prefer to leave this SIBXX without a validity timer. If there is support use of the same Timer for SIB31 can be considered for connected mode measurements if the UE acquired this SIB prior to entering into connected mode. |
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**Rapporteur Summary**

**Triggers for neighbor cell measurement**

Proposal 10 from [offline-102] Mobility enhancements [1] has gained the majority support (13/16). But it has not been discussed during the RAN2#122 online session due to limited time. Rapport would like to discuss this proposal again.

Proposal 10 (13/16) For NB-IoT NTN, location-based measurement initiation can also be used in RRC\_IDLE for cell re-selection purposes (like in NR-NTN), with the assumption that it is up to the UE to update GNSS location.

**Q6: Do companies agree that for NB-IoT NTN, location-based measurement initiation can also be optionally used in RRC\_IDLE for cell re-selection purposes (like in NR-NTN), with the assumption that it is up to the UE to update GNSS location?**

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| **Company** | **Agree/Disagree** | **Comments** |
| Huawei, HiSilicon | Agree |  |
| Apple | Agree | Any way it is an optional feature thus UE can choose to implement it or not. |
| CATT | Agree |  |
| MediaTek | Agree |  |
| Qualcomm | Agree | But we already have the following agreement.   * R18 location and time based trigger for measurements (for connected mode and for idle) apply to both NB-IoT and eMTC. |
| ZTE | Agree |  |
| Lenovo | Agree |  |
| Samsung | Agree |  |
| Xiaomi | Agree |  |
| Ericsson | Agree |  |
| Nokia | Agree |  |
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**Rapporteur Summary**

# Conclusion

Proposals for agreements:

# Reference

[1] R2-2306642 [offline-102] Mobility enhancements Qualcomm discussion Rel-18 IoT\_NTN\_enh-Core

[2] R2-2306664 [offline-102] Mobility enhancements– second round Qualcomm discussion Rel-18 IoT\_NTN\_enh-Core

[3] R2-2306665 [offline-113] Measurements before RLF Interdigital discussion Rel-18 IoT\_NTN\_enh-Core

[4] R2-2306954 Running CR - Introduction of IoT NTN enhancements Huawei, HiSilicon draftCR Rel-18 36.331 17.4.0 B IoT\_NTN\_enh-Core