[106bis-e][231] IoT_NTN_enh - Version 0.0.6
RAN4
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3GPP TSG-RAN WG4 Meeting #106bis-e R4-2306262

Online, April 17 – April 26, 2023

Agenda item: 6.9.5

Source: Moderator (MediaTek inc.)

Title: Topic summary for [106bis-e][231] IoT_NTN_enh

Document for: Information

1 Introduction

This document is the topic summary for RRM requirements for R18 IoT (Internet of Things) NTN (non-terrestrial network) enhancements, including the following topics covered

- Topic#1: RRM core requirements (AI 6.9.4)

List of candidate target of discussions for this topic.

- 1st round: Decide on the scope, priority, options and tentative agreement to be discussed in the 2nd round. Conclude issues with strict consensus, if any.
- 2nd round: Conclude the issues identified in the 1st round.

2 Topic #1: RRM core requirements (AI 6.9.4)

Main technical topic overview. The structure can be done based on sub-agenda basis.

2.1 Companies' contributions summary

Table 1: Companies' contributions summary

T-doc number	Company	Proposals / Observations

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R4-2304502	Nokia, Nokia Shanghai Bell	Proposal 1: RAN4 to clarify whether the previously agreed number of satellites UE needs to monitor correspond to parallel measurements or the overall number of satellites monitored per frequency layer. Proposal 2: For NGSO, RAN4 to discuss whether to include scaling factor for the requirements (Tdetect, Tevaluate, Tmeasure) for RRC Idle measurement across multiple satellites as introduced in NR (for both, intra and inter frequency measurements). Proposal 3: Introduce a new capability for UE capable to measure more than [2] satellites in parallel.

R4-2304651	CMCC	Proposal 1: The requirements which not applicable due to lack of neighbour cell ephemeris in R17 could be applied in R18, the requirements defined during R17 can be the starting point for further discussion. Proposal 2: For NB neighbour cell measurement in connected mode, the impaction of NGSO satellites measurement capability should be considered, which is to scale up the delay requirements for NGSO measurement by Ksatellite, Ksatellite is the number NGSO satellites to be measured. Proposal 3: NB For neighbour cell measurement in connected mode, the impaction of GNSS measurement gap should be considered. The measurement occasion should also fulfill the condition that the resources are not colliding with GNSS measurement gap. Proposal 4: For NB-IOT NTN of quasi-earth fixed cell and earth-moving cell, RAN4 should introduce time-based and location-based connected mode measurement initiation condition in core spec according to RAN2's design. The details such as exact measurement starting time should wait further progress of RAN2. Proposal 5: Define RRM requirements for time-based and location-based CHO for both normal and enhanced coverage for eMTC. For the specific delay requirement development, wait further progress of RAN2.

R4-2304823	MediaTek inc.	Observation 1: The need for RAN4 Core requirements for enhancement regarding GNSS operation will be identified after the conclusion on the need for improvements. Observation 2: The following RRM requirement could be impacted, For NB-IoT, the RRM requirement for neighbour cell measurements in connected mode For eMTC, the RRM requirement for the location-based CHO Proposal 1: For quasi-Earth fixed case, NB-IoT requirements for connected mode measurement upon *t-Service* can be further discussed. Proposal 2: For both quasi-Earth fixed and earth-moving cell, requirements for location-based connected mode measurement can be further discussed. Observation 3: Both of time and location based trigger event will be introduced by RAN2. Proposal 3: For eMTC CHO, the requirements for both time and location-based CHO can be further discussed.

R4-2305263	Huawei, HiSilicon	Observation 1: The triggering methods for neighbour cell measurement in connected mode before RLF are as follows: Quasi-earth fixed cell: Legacy NRSRP based triggering T-service based triggering (the exact time to start measurements is up to UE implementation) Location based triggering: reference location + distance threshold Earth-moving cell: Legacy NRSRP based triggering Location based triggering: reference location + distance threshold Observation 2: The inter-frequency measurement in connected mode before RLF is "best efforts" measurement using vacant time slot, where the exact time for inter-frequency neighbour cell detection and measurement is unpredictable. Proposal 1: RAN4 to discuss whether to define requirements for t-service triggered neighbour cell measurement in connected mode before RLF. Proposal 2: For location-based triggering, add the corresponding criteria (reference location and distance threshold) and the same requirements as NRSRP based triggering can apply. Proposal 3: RAN4 should further wait for RAN2 progress before discussing exact requirements for time and [location based] CHO for eMTC. Observation 3: For NW triggered GNSS re-acquisition, there is not much RAN4 works expected. The potential impact could be the gap pattern to be captured in RAN4 spec if needed. Observation 4: More progress on NW triggered GNSS re-acquisition and UE autonomous re-acquisition is needed before RAN4 to identified the impacts on RAN4 specification.

R4-2305733	Ericsson	The NB-IoT UE shall start the intra/inter-frequency measurements at least before time T1 before start of t-Service, where T1 is the time required to perform one measurement. For CONNECTED mode NB-IoT neighbour cell measurements, the legacy requirements from Rel-17 LTE NB-IoT WI can be reused with some modifications for the triggering conditions. Observation 1: RAN2 has agreed to define location and time based CHO for eMTC over NTN. Observation 2: Similarities observed for the conditional handover requirements for NR NTN and IoT NTN. For eMTC over NTN, RAN4 shall define requirements for location- and time based conditional handover following the methods used in NR NTN conditional handover requirements. RAN4 to postpone the discussions on GNSS re-acquisition until more progress has been reached on this objective in other WGs.

2.2 Open issues summary

2.2.1 RRM core requirements

2.2.1.1 Issue 1-1: Measurement capabilities on number of NGSO satellites

Background:

RAN4 #105 agreement in WI LTE_NBIoT_eMTC_NTN_req:

- *The minimum of the UE capability on the total number of the NGSO satellites across the layers is [2].*
- *For NB in IDLE and M1 in both IDLE and CONNCTED, the UE shall be capable of monitoring*
  - *for intra-frequency carrier, the number of target satellites UE needs to monitor is [2] including serving LEO satellite.*

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- *for inter-frequency carrier, the number of target satellites UE needs to monitor per carrier is [2] if one of the target satellites include the UE serving satellite; the number of target satellites UE needs to monitor is [1] otherwise.*

Proposals:

- Proposal 1: RAN4 to clarify whether the previously agreed number of satellites UE needs to monitor correspond to parallel measurements or the overall number of satellites monitored per frequency layer. (Nokia)
- Proposal 2: Introduce a new capability for UE capable to measure more than [2] satellites in parallel. (Nokia)

Recommended WF: Discuss proposals.

Discussion in offline session:

- Ericsson: the current wording could be unclear. May need to revise.
- Nokia: wording issue. Can try to revise wording.
- QUALCOMM: not for parallel measurements

Conclusion in offline session:

- For Proposal 1, no need further discussion.
- For Proposal 2, wait for more RAN2 progress.

Feedback Form 1: Issue 1-1: Measurement capabilities on number of NGSO satellites

1 – MediaTek Inc.

Our understanding is the previous agreement is on number of satellites monitored per frequency layer and not for parallel measurements.

Whether to support parallel measurements can be further discussed. We think IoT devices are expected with low complexity, so the need to introduce advanced measurement capability will need more discussion.

2 – Qualcomm Incorporated

Comment on Proposal 1:

It was the total number of the NGSO satellites across frequency layers.

Comment on Proposal 2:

We would like to wait at least until RAN2 finalizes their work on neighbor-satellite information signaling.

Comment on both proposals:

We think the capability was not meant for parallel measurement.

3 – HUAWEI TECHNOLOGIES Co. Ltd.

To P1: The total number cross layers is 2 as the minimum capability. For instance, UE shall be able to monitor 2 satellites for intra-frequency or 1 for inter-frequency and 1 for inter-frequency.

To P2: We are open to discuss.

4 – China Mobile Com. Corporation

To proposal 1: In our perspective, the previously agreed number of satellites UE needs to monitor correspond to the overall number of satellites monitored per frequency layer.

To Proposal 2: We share similar concern as MTK, IoT devices are with low cost and low complexity, whether it could support parallel measurement is unclear. However, we are open to have further more discussion.

5 – Nokia France

As proponents of the clarification, we appreciate the answers provided by other companies. No need to further discuss Proposal 1 in this item. For proposal 2, we are ok in waiting for more RAN2 progress.

6 – Ericsson Hungary Ltd

For proposal 1, we have similar understanding as other companies. For proposal 2, we are also fine to wait for more RAN2 progress on this issue.

2.2.1.2 Issue 1-2: Scaling factor for multiple NGSO satellites

Proposals:

- Proposal 1: For NGSO, RAN4 to discuss whether to include scaling factor for the requirements (T_{detect}, $T_{evaluate}$, $T_{measure}$) for RRC Idle measurement across multiple satellites as introduced in NR (for both, intra and inter frequency measurements). (Nokia)
- Proposal 2: For NB neighbour cell measurement in connected mode, the impaction of NGSO satellites measurement capability should be considered, which is to scale up the delay requirements for NGSO measurement by $K_{satellite}$, $K_{satellite}$ is the number NGSO satellites to be measured. (CMCC)

Recommended WF: Discuss whether to introduce scaling factor in IDLE and in CONNECTED mode.

Tentative agreement in offline session:

- include scaling factor for multiple NGSO satellites for RRC Idle measurement requirements (Tdetect, Tevaluate, Tmeasure)

- FFS the need to introduce scaling factor for multiple NGSO satellites for NB neighbour cell measurement in connected mode
    - Intra-frequency
    - Inter-frequency

Feedback Form 2: Issue 1-2: Scaling factor for multiple NGSO satellites

1 – MediaTek Inc. We support to introduce scaling factor for multiple NGSO satellites IDLE mode requirements and also NB neighbour cell measurement in connected mode. For IDLE mode, our understanding is the scaling factor has been agreed in R4-2217264 (RAN4 104-bis-e) in WI LTE_NBIOT_eMTC_NTN_req and we'd like to keep the scaling factor to make the requirement more general. If the scaling facto is missing in some clauses, we can fix it in the CR. For NB neighbour cell measurement in connected mode, it is a new feature in R18 and we think it can apply the same principle to apply the scaling factor.
2 – Qualcomm Incorporated In principle, we agree with both proposals.
3 – HUAWEI TECHNOLOGIES Co. Ltd. Generally fine with P1 and P2.
4 – China Mobile Com. Corporation Ok with P1 and the further clarification from MTK, Support P2.
5 – Ericsson Hungary Ltd There is already an agreement to introduce scaling factor related to the number of NGSO satellites. So we are fine with proposals for IDLE mode except for Rel-18 CONNECTED mode neighbour cell measurements for NB-IoT for which more discussions are needed. RAN4 needs to first identify the criteria for measurements since the inter-frequency measurements are already "best-effort" measurements and more discussions are needed whether scaling factor is needed to be added.

2.2.1.3 Issue 2: Requirements which not applicable due to lack of neighbor cell ephemeris

Background:

In RAN4 #106:

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- *Conclusion: postpone discussion till the related open issues for NB-IoT/eMTC core & perf. requirements for NTN WI are resolved*

Proposals:

- Proposal 1: The requirements which not applicable due to lack of neighbour cell ephemeris in R17 could be applied in R18, the requirements defined during R17 can be the starting point for further discussion. (CMCC)

Recommended WF: Suggest not to discuss in the first round.

——————— Below is for 2nd round discussion and will be removed in Formal WF ———————

Proposals

- Proposal 1: The requirements which not applicable due to lack of neighbour cell ephemeris in R17 could be applied in R18, the requirements defined during R17 can be the starting point for further discussion. (CMCC)

Recommended WF

- Agree on Proposal 1, or suggest necessary adjustment.

Table 2:

Company	**Comments**
MTK	Agree on Proposal 1
Huawei	Fine with proposal 1.
Ericsson	We are also fine with proposal 1.
Nokia	Fine with proposal 1.

2.2.1.4 Issue 3-1: Neighbour cell measurements in connected mode, time-based

Background:

RAN4 #106 agreement

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- The mechanism for defining the neighbour cell measurements in CONNECTED mode for NB-IoT from Rel-17 WI can be reused as baseline for NB-IoT NTN while NTN specific impact needs investigation.

Proposals:

- Proposal 1: RAN4 to discuss whether to define requirements for *t-service* triggered neighbour cell measurement in connected mode before RLF. (Huawei)
- Proposal 2: For NB-IOT NTN of quasi-earth fixed cell and earth-moving cell, RAN4 should introduce time-based and location-based connected mode measurement initiation condition in core spec according to RAN2's design. The details such as exact measurement starting time should wait further progress of RAN2. (CMCC)
- Proposal 3: For quasi-Earth fixed case, NB-IoT requirements for connected mode measurement upon t-Service can be further discussed. (MTK)
- Proposal 4: The NB-IoT UE shall start the intra/inter-frequency measurements at least before time T1 before start of t-Service, where T1 is the time required to perform one measurement. (Ericsson)
- Proposal 5: For CONNECTED mode NB-IoT neighbour cell measurements, the legacy requirements from Rel-17 LTE NB-IoT WI can be reused with some modifications for the triggering conditions. (Ericsson)

Moderator's Note: Proposal 5 has been agreed in the last meeting.

Recommended WF:

- For quasi-earth fixed cell, RAN4 to discuss whether to define requirements for *t-service* triggered neighbour cell measurement before RLF. FFS the following options:
    - Option 1: The NB-IoT UE shall start the intra/inter-frequency measurements at least before time T1 before start of t-Service, where T1 is the time required to perform one measurement. (Ericsson)
    - Option 2: RAN4 to define time-based connected mode measurement initiation condition in core spec. The details such as exact measurement starting time should wait further progress of RAN2. (CMCC)
    - Option 3: not to define.
    - Other options are not precluded.

Tentative agreement in offline session:

- For quasi-earth fixed cell for NB-IoT, RAN4 to discuss whether to define requirements for *t-service* triggered neighbour cell measurement before RLF. FFS the following options:
    - Option 1: The NB-IoT UE shall start the intra/inter-frequency measurements at least before time T1 before start of t-Service, where T1 is the time required to perform one measurement.

- Option 2: RAN4 to define time-based connected mode measurement initiation condition in core spec. The details such as exact measurement starting time should wait further progress of RAN2.
- Option 3: not to define.
- Other options are not precluded.

Feedback Form 3: Issue 3-1: Neighbour cell measurements in connected mode, time-based

1 – MediaTek Inc. We can support Option 2.
2 – Qualcomm Incorporated No strong opinion yet.
3 – HUAWEI TECHNOLOGIES Co. Ltd. We are fine to further discuss it with more RAN2's inputs. The problem here is that we can not figure out a deterministic T1 as mentioned in option 1. In Rel-17 discussion, the actual time UE needs for neighbor cell measurement is variable depends on the available vacant time period. So it maybe difficult to define a constant T1 in the spec like Ttrigger.
4 – China Mobile Com. Corporation We support Option 2.
5 – Nokia France We support Option 2. We have to wait for further design from RAN2. . It is our understanding that RAN2 is discussing to provide UE with the information about the availability of target cell also in non-discontinuous coverage (R2-2303652) and also discussing improvements for RLF procedures.
6 – Ericsson Hungary Ltd We support option 1. To Huawei, at least the intra-frequency measurement delay is deterministic but inter-frequency is expressed using a formula that depends on vacant slot which is correct. Perhaps option 1 can be applied to intra-frequency measurements and it can be FFS for inter-frequency. Since many companies prefer to wait for further RAN2 progress on this issue, we are also fine with that.

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2.2.1.5 Issue 3-2: Neighbour cell measurements in connected mode, location-based

Proposals:

- Proposal 1: For location-based triggering, add the corresponding criteria (reference location and distance threshold) and the same requirements as NRSRP based triggering can apply. (Huawei)
- Proposal 2: For NB-IOT NTN of quasi-earth fixed cell and earth-moving cell, RAN4 should introduce time-based and location-based connected mode measurement initiation condition in core spec according to RAN2's design. The details such as exact measurement starting time should wait further progress of RAN2. (CMCC)
- Proposal 3: For both quasi-Earth fixed and earth-moving cell, requirements for location-based connected mode measurement can be further discussed. (MTK)

Recommended WF:

  - For quasi-earth fixed cell and earth-moving cell, RAN4 to define location-based connected mode measurement initiation condition in core spec. The details such as exact measurement starting time should wait further progress of RAN2

Tentative agreement in offline session:

- Agree with Recommended WF.

Feedback Form 4: Issue 3-2: Neighbour cell measurements in connected mode, location-based

1 – MediaTek Inc. Agree with Recommended WF
2 – Qualcomm Incorporated Okay with Recommended WF.
3 – HUAWEI TECHNOLOGIES Co. Ltd. Fine with recommended WF.
4 – China Mobile Com. Corporation Support the recommended WF

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5 – Nokia France Support recommended WF.
6 – Ericsson Hungary Ltd We are also fine with the recommended WF.

2.2.1.6 Issue 4: For eMTC, CHO requirements

Background:

RAN4 #106 agreement

- *Define RRM requirements for time and [location based] CHO based on further RAN2 progress.*
- *Define RRM requirements for time and [location based] CHO for both normal and enhanced overage for eMTC.*

Proposals:

- Proposal 1: RAN4 should further wait for RAN2 progress before discussing exact requirements for time and [location based] CHO for eMTC. (Huawei)
- Proposal 2: Define RRM requirements for time-based and location-based CHO for both normal and enhanced coverage for eMTC. For the specific delay requirement development, wait further progress of RAN2. (CMCC)
- Proposal 3: For eMTC CHO, the requirements for both time and location-based CHO can be further discussed. (MTK)
- Proposal 4: For eMTC over NTN, RAN4 shall define requirements for location- and time based conditional handover following the methods used in NR NTN conditional handover requirements. (Ericsson)

Recommended WF:

- Define RRM requirements for time-based and location-based CHO for both normal and enhanced coverage for eMTC. For the specific delay requirement development, wait further progress of RAN2.

Tentative agreement in offline session:

- Define RRM requirements for time-based and location-based CHO for both normal and enhanced coverage for eMTC. For the specific delay requirement development, wait further progress of RAN2.

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- Note: the enhanced coverage is legacy function

Feedback Form 5: Issue 4: For eMTC, CHO requirements

1 – MediaTek Inc. Agree with Recommended WF
2 – Qualcomm Incorporated Okay with Recommended WF.
3 – HUAWEI TECHNOLOGIES Co. Ltd. Fine with recommended WF.
4 – China Mobile Com. Corporation Support the recommended WF
5 – Nokia France Support the recommended WF.
6 – Ericsson Hungary Ltd We are also fine with the recommended WF.

2.2.1.7 Issue 5: GNSS re-acquisition

Background:

RAN4 #106 agreement

- *RAN4 to postpone the discussions on GNSS re-acquisition until more progress has been reached on this objective in other WGs.*

Proposals:

- Proposal 1: For NB neighbour cell measurement in connected mode, the impaction of GNSS measurement gap should be considered. The measurement occasion should also fulfill the condition that the resources are not colliding with GNSS measurement gap. (CMCC)

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- Proposal 2: RAN4 to postpone the discussions on GNSS re-acquisition until more progress has been reached on this objective in other WGs. (Ericsson)

Recommended WF: Suggest not to discuss in this meeting to wait for more progress.

2.3 Summary for 1st round

2.3.1 Open issues

2.3.1.1 Issue 1-1: Measurement capabilities on number of NGSO satellites

Conclusion in offline session:

- For Proposal 1, no need further discussion.
- For Proposal 2, wait for more RAN2 progress.

Recommendations for 2nd round: No discussion in 2nd round.

2.3.1.2 Issue 1-2: Scaling factor for multiple NGSO satellites

Tentative agreement in offline session:

- include scaling factor for multiple NGSO satellites for RRC Idle measurement requirements (Tdetect, Tevaluate, Tmeasure)
- FFS the need to introduce scaling factor for multiple NGSO satellites for NB neighbour cell measurement in connected mode
    - Intra-frequency
    - Inter-frequency

Recommendations for 2nd round: No discussion in 2nd round.

2.3.1.3 Issue 2: Requirements which not applicable due to lack of neighbor cell ephemeris

No discussion in the 1st round.

Recommendations for 2nd round: Discuss the following proposal:

- Proposal 1: The requirements which not applicable due to lack of neighbour cell ephemeris in R17 could be applied in R18, the requirements defined during R17 can be the starting point for further discussion. (CMCC)

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2.3.1.4 Issue 3-1: Neighbour cell measurements in connected mode, time-based

Tentative agreement in offline session:

- For quasi-earth fixed cell for NB-IoT, RAN4 to discuss whether to define requirements for *t-service* triggered neighbour cell measurement before RLF. FFS the following options:
  - Option 1: The NB-IoT UE shall start the intra/inter-frequency measurements at least before time T1 before start of t-Service, where T1 is the time required to perform one measurement.
  - Option 2: RAN4 to define time-based connected mode measurement initiation condition in core spec. The details such as exact measurement starting time should wait further progress of RAN2.
  - Option 3: not to define.
  - Other options are not precluded.

Recommendations for 2nd round: No discussion in 2nd round. Discuss in the next meeting.

2.3.1.5 Issue 3-2: Neighbour cell measurements in connected mode, location-based

Recommended WF:

- For quasi-earth fixed cell and earth-moving cell, RAN4 to define location-based connected mode measurement initiation condition in core spec. The details such as exact measurement starting time should wait further progress of RAN2

Tentative agreement in offline session:

- Agree with Recommended WF.

Recommendations for 2nd round: No discussion in 2nd round.

2.3.1.6 Issue 4: For eMTC, CHO requirements

Tentative agreement in offline session:

- Define RRM requirements for time-based and location-based CHO for both normal and enhanced coverage for eMTC. For the specific delay requirement development, wait further progress of RAN2.
  - Note: the enhanced coverage is legacy function

Recommendations for 2nd round: No discussion in 2nd round.

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2.3.1.7 Issue 5: GNSS re-acquisition

not to discuss in this meeting to wait for more progress.

Recommendations for 2nd round: No discussion in 2nd round.

3 Recommendations for Tdocs

3.1 1st round

New tdocs

Table 3:

New Tdoc number	Title	Source	Comments
	WF on IoT_NTN_enh	MediaTek	

Existing tdocs

None

3.2 2nd round

Table 4:

Tdoc number	Revised to	Title	Source	Recommenda-tion	Comments
R4-2306387		WF on RRM requirements for IoT NTN enhancements	MediaTek	Agreeable	

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