**3GPP TSG RAN WG1 Meeting #115 R1-2312298**

**Chicago, USA, November 13th – November 17th, 2023**

**Agenda Item: 8.13.4**

**Source: Moderator (MediaTek)**

**Title: Feature lead summary #1** **of AI 8.13.4 on improved GNSS operations**

**Document for: Discussion**

# 0 Introduction

## 0.1 Background

In RAN#98e, the revised WID on IoT NTN enhancements has been endorsed for Release 18 [1].

The work item aims to specify further enhancements for E-UTRA (LTE-RAN) based NTN (non-terrestrial networks) according to the following assumptions:

- GEO and NGSO (LEO and MEO).

- Earth fixed Tracking area. Earth fixed & Earth moving cells for NGSO

- FDD mode

- UEs with GNSS capabilities

The detailed objectives are to specify enhanced NB-IoT NTN and eMTC NTN radio interfaces and E-UTRAN/NG-RAN as follows:

4.1.1 IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

This work considers Rel-17 IoT-NTN as baseline as well as Rel-17 NR-NTN outcome and the further IoT-NTN performance enhancements objectives are listed below:

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1,RAN2]

- Study and specify needed improved GNSS operations for a new position fix for UE pre-compensation during long connection times and for reduced power consumption. Simultaneous GNSS and NTN NB-IoT/eMTC operation is not assumed. [RAN1, RAN2]

* *NOTE: The need for RAN4 Core requirements for this objective will be identified after the conclusion on the need for improvements.*

In this meeting, company views on remaining issues of improved GNSS operations for IoT NTN are summarized and proposals on identified issues are made.

## 0.2 Contact Information

Please help to fill in the contact information for the FL summary. (If any change, please revise.)

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# [Active] Issue #1: UL transmission after original validity duration expires and potential enhancements

**Agreement (RAN1 106e):**

For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops shall be supported for IoT-NTN

**Agreement (RAN1 109e):**

Closed loop time and frequency correction, with potential enhancements, for IoT-NTN is considered to reduce the need for UE to update GNSS position fix in long connection time

**Agreement (RAN1 112):**

At least for the case when frequency error is within frequency error requirements, study the mechanisms and conditions to allow UL transmission after original GNSS validity duration expires without GNSS re-acquisition for some duration.

* FFS: with legacy closed loop time correction or enhanced closed loop time correction
* This mechanism is enabled/configured by eNB
* FFS: whether such mechanism will be specified depends on the outcome of this study

**Agreement (RAN1 113):**

From RAN1 perspective, at least for the case when frequency error and timing error are within frequency and timing error requirements with legacy closed loop time correction, UL transmission can be allowed in a duration X after original GNSS validity duration expires without GNSS re-acquisition.

RAN1 will decide further details of the above.

**Agreement (RAN1 114):**

From RAN1 perspective, down select one for the duration X:

· Alt-3: when timeAlignmentTimer is not infinity, X is equal to remaining timeAlignmentTimer;

 when timeAlignmentTimer is infinity, X is equal to Y;

 o FFS: whether X can be used to extend the original GNSS validity duration

 o Y is a configured value.

Note 1: The feature can be enabled/disabled by network

Note 2 (as already agreed): The duration X is where UL transmission can be allowed after original GNSS validity duration expires without GNSS re-acquisition.

**Agreement (RAN1 114bis):**

When timeAlignmentTimer is infinity, the duration X is equal to Y. Network can configure Y via a 3-bit field at least with component values [sf500, sf750, sf1280, sf1920, sf2560, sf5120, sf10240].

FFS: whether there is a new value.

**Agreement (RAN1 114bis):**

The feature of *“UL transmission after original validity duration expires with duration X”* can be enabled/disabled by network via RRC signalling.

**RAN2-121bis**

1. UE can stay in RRC\_CONNECTED state when current GNSS position becomes out-of-date if the UE enters a GNSS measurement gap. FFS whether the new GNSS measurement shall be started before, upon or after the current GNSS validity duration expiry

**RAN2-123**

If there is neither network aperiodically trigger nor network configuration of UE autonomously GNSS measurement, UE moves to RRC\_IDLE after GNSS becomes invalid. It’s FFS how to decide GNSS valid or invalid considering duration X and Y.

## Company contributing views

|  |  |
| --- | --- |
| Contribution | Observation/Proposals |
| Huawei, HiSilicon | Proposal 1: If TAT is infinite, a separate timer T is configured with length of Y ms. The timer T is restarted every time when UE receives a TAC command. UL transmission is not allowed without GNSS re-acquisition after both original GNSS validity duration and timer T expire.Proposal 2: No need to introduce additional component value of Y smaller than 500 subframes. |
| Spreadtrum | Proposal 1: The latest GNSS position fix obtained before duration X is triggered, can be utilized for calculating UE-Specific TA for uplink transmission within duration X. |
| ZTE | Proposal 1: From RAN1 perspective, the GNSS position obtained before duration X, can be utilized for calculating for uplink transmission within duration X.  |
| OPPO | Proposal: When TAT timer is set to infinite, the X is reset when receiving a MAC CE providing a TAC. |
| NEC | Proposal 1: Closed-loop frequency correction mechanism is not needed for IoT NTN for Rel18.Proposal 2: No need to further discuss the issue of accumulated timing error in for IoT NTN Rel18. |
| Xiaomi | Proposal 1: It could be up to UE’s implementation to perform the autonomous TA adjustment during the extended duration. |
| Nokia, NSB | Observation 2: the eNB may transmit a Timing Advance Command prior to the GNSS validity duration expiry without intending to extend the GNSS validity duration expiry by the corresponding restart of the timeAlignmentTimer.Proposal 2: RAN1 to discuss whether the duration, for allowed uplink transmission after expiry of the GNSS validity duration, can be extended multiple times and how this can be achieved.Observation 3: If the uplink transmission is allowed in a duration X after expiry of the original GNSS validity duration, the UE cannot perform uplink pre-compensation based on UE location unless the duration X also extends the GNSS validity duration.Observation 4: The eNB can provide Timing Advance Commands to the UE during the duration X, if the UE is not allowed to perform uplink pre-compensation based on the old UE location. The eNB can trigger a new aperiodic GNSS measurement gap if needed.Observation 5: The eNB, or alternatively specification, must decide if the UE’s old GNSS location can be used for uplink transmit pre-compensation during the extension X.Proposal 3: RAN1 to discuss whether option 1 (reuse GNSS) or 2 (rely on TAC) for TA adjustment during extended duration is used or can be configured by the eNB.Observation 6: If the UE transmits using segments during the duration X, the UE will not monitor for Timing Advance Commands, to adjust the timing advance per segment, during the segmented transmission.Proposal 4: If the UE is not allowed to use the old UE location during duration X, RAN1 needs to define whether 1) eNB cannot schedule segmented transmissions or 2) provides a TAC per segment prior to starting the repetition period.Proposal 5: There is no need for additional new values for Y (configurable timer for extending uplink). |
| Apple | Proposal 1: During duration X where UL transmission is allowed, UE considers the UL synchronization is valid and there is no need to extend the GNSS validity duration.Proposal 2: No special handling is needed to determine the timing advance within duration X. |
| Samsung | Proposal 4: Support closed loop correction for pre-compensated frequency offset, e.g., absolute frequency command and/or frequency adjustment command can be considered. |
| Ericsson | Proposal 1: RAN1 to adopt an additional value for the parameter Y e.g. 100 ms or 250 ms.Observation 1: Introducing a new duration or timer for the GNSS extension duration is a cleaner solution than extending the existing GNSS validity duration. Observation 2: RAN2 can decide whether the GNSS extension duration X is configured by directly extending the GNSS validity duration or by introducing a new GNSS extension duration or timer. |
| MediaTek | Observation 1: UL transmission can be allowed in one duration X after original GNSS validity duration expires without GNSS re-acquisition.Observation 2: The start time of duration X should be at the point where original GNSS validity duration expires.Observation 3: In legacy timing alignment procedure, the timeAlignmentTimer is reset every time when MAC CE TAC is received.Proposal 1: From RAN1 perspective, the start time of one duration X should be at the point where original GNSS validity duration expires:* When timeAlignmentTimer is not infinity, the end of X should be at the point where timeAlignmentTimer expires and the timeAlignmentTimer is reset every time when MAC CE TAC is received.
* When timeAlignmentTimer is infinity, the length of X should be equal to a single configured value Y without extension when MAC CE TAC is received.
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| Qualcomm | Observation 1: According to current specifications, any time a UE transmits a NPRACH, it uses a value of .Observation 2: If a considerable amount of time has passed since the last GNSS position fix the accuracy of becomes progressively worse over time.Observation 3: Although the eNB can progressively correct (by issuing TA commands) the timing error due to a stale UE location, this correction is not applied when transmitting NPRACH (which currently uses . This may cause the timing error to go beyond the NPRACH correction capability.Proposal 3: If the UE is configured with GNSS validity extension (duration X), the UE applies the accumulated for (N)PRACH transmission.* Adopt TP2.1 (36.211) and TP2.2 (36.213)

Proposal 4: Upon reception of a closed loop command with the purpose of “allowing UL transmission after original GNSS validity duration expires without GNSS re-acquisition for some duration”, the UE starts a closed loop timer:* The “duration X” is counted starting from the time the UE receives the closed loop command.
	+ When timeAlignmentTimer is infinity, the “configured value Y” for “duration X” is applied from the time the UE receives the closed loop command.
* The UE may be issued multiple closed loop commands to keep on extending this allowable duration of UL transmission (by resetting the closed loop timer with every command).
* The UE moves back to IDLE or re-acquires GNSS (if autonomous gaps are configured) if both the closed loop timer and the GNSS validity duration are expired.
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| Nordic Semiconductor ASA | Proposal 1: The timer for an extension period X is separate from the timer for GNSS validation duration and it is started or re-started upon a reception of a TAC by the UE, and the timer value is equal to TAT or Y if TAT is infinity. |

In RAN1 #114 meeting, RAN1 agreed for the duration X where UL transmission can be allowed after original GNSS validity duration expires without GNSS re-acquisition, when timeAlignmentTimer is not infinity, X is equal to remaining timeAlignmentTimer; when timeAlignmentTimer is infinity, X is equal to Y and Y is a configured value. Later in RAN1 #114bis, it is agreed that Network can configure Y via a 3-bit field at least with component values [sf500, sf750, sf1280, sf1920, sf2560, sf5120, sf10240].

Contributing companies discussed about duration X/ Y and related issues/enhancements.

1. **Length/configuration of duration X/Y when TAT is infinite**

Huawei, HiSilicon, OPPO, Qualcomm, Nordic proposed duration X(Y) can be reset/restarted when TAT is infinite.

MediaTek proposed duration X(Y) cannot be reset/restarted when TAT is infinite.

Huawei, HiSilicon, Nokia, NSB proposed no need to introduce additional component value of Y.

Ericsson proposed to introduce additional component value of Y.

* Huawei, HiSilicon mentioned if TAT is infinite, a separate timer T is configured with length of Y ms. The timer T is restarted every time when UE receives a TAC command. UL transmission is not allowed without GNSS re-acquisition after both original GNSS validity duration and timer T expire.
* OPPO proposed when TAT timer is set to infinite, the X is reset when receiving a MAC CE providing a TAC.
* Ericsson proposed RAN1 to adopt an additional value for the parameter Y e.g. 100 ms or 250 ms.
* MediaTek observed UL transmission can be allowed in one duration X after original GNSS validity duration expires without GNSS re-acquisition and the start time of duration X should be at the point where original GNSS validity duration expires. MediaTek proposed the start time of one duration X should be at the point where original GNSS validity duration expires when timeAlignmentTimer is infinity, the length of X should be equal to a single configured value Y without extension when MAC CE TAC is received as depicted in Figure 2 of R1-2311999.



**Figure 2:** The start time and length of duration X (Y), when timeAlignmentTimer is infinity

* Qualcomm proposed Upon reception of a closed loop command with the purpose of “allowing UL transmission after original GNSS validity duration expires without GNSS re-acquisition for some duration”, the UE starts a closed loop timer: the “duration X” is counted starting from the time the UE receives the closed loop command and when timeAlignmentTimer is infinity, the “configured value Y” for “duration X” is applied from the time the UE receives the closed loop command where the UE may be issued multiple closed loop commands to keep on extending this allowable duration of UL transmission (by resetting the closed loop timer with every command) and the UE moves back to IDLE or re-acquires GNSS (if autonomous gaps are configured) if both the closed loop timer and the GNSS validity duration are expired as depicted in Figure 1 of R1-2312054. To the moderator understanding, Y should be the value of the duration between the end of original GNSS validity duration expires to the end of UL transmission extension.



Figure 1: Diagram showing the interaction of closed loop commands and validity duration: the UE moves to IDLE (or reacquires GNSS) upon expiration of both the timer and validity duration.

* Nordic proposed the timer for an extension period X is separate from the timer for GNSS validation duration and it is started or re-started upon a reception of a TAC by the UE, and the timer value is equal to TAT or Y if TAT is infinity.
1. **Length/configuration of duration X when TAT is not infinite**

Qualcomm, Nordic preferred X is another timer configured by network.

Ericsson preferred to up to RAN2 to decide whether X can be used to extend the original GNSS validity duration.

* Ericsson mentioned introducing a new duration or timer for the GNSS extension duration is a cleaner solution than extending the existing GNSS validity duration and RAN2 can decide whether the GNSS extension duration X is configured by directly extending the GNSS validity duration or by introducing a new GNSS extension duration or timer.
* MediaTek observed UL transmission can be allowed in one duration X after original GNSS validity duration expires without GNSS re-acquisition and the start time of duration X should be at the point where original GNSS validity duration expires. MediaTek proposed from RAN1 perspective, the start time of one duration X should be at the point where original GNSS validity duration expires when timeAlignmentTimer is not infinity, the end of X should be at the point where timeAlignmentTimer expires and the timeAlignmentTimer is reset every time when MAC CE TAC is received as depicted in Figure 1 of R1-2311999.



**Figure 1:** The start time and length of duration X, when timeAlignmentTimer is not infinity

* Qualcomm proposed Upon reception of a closed loop command with the purpose of “allowing UL transmission after original GNSS validity duration expires without GNSS re-acquisition for some duration”, the UE starts a closed loop timer: the “duration X” is counted starting from the time the UE receives the closed loop command where the UE may be issued multiple closed loop commands to keep on extending this allowable duration of UL transmission (by resetting the closed loop timer with every command) and the UE moves back to IDLE or re-acquires GNSS (if autonomous gaps are configured) if both the closed loop timer and the GNSS validity duration are expired as depicted in Figure 1 of R1-2312054.



Figure 1: Diagram showing the interaction of closed loop commands and validity duration: the UE moves to IDLE (or reacquires GNSS) upon expiration of both the timer and validity duration.

* Nordic proposed the timer for an extension period X is separate from the timer for GNSS validation duration and it is started or re-started upon a reception of a TAC by the UE, and the timer value is equal to TAT or Y if TAT is infinity.
1. **TA calculation within duration X**

Spreadtrum, ZTE, Apple proposed the latest GNSS position fix obtained before duration X is triggered, can be utilized for calculating for uplink transmission within duration X.

Xiaomi proposed it could be up to UE’s implementation to perform the autonomous TA adjustment during the extended duration.

Qualcomm, Nordic proposed to not reset for (N)PRACH transmission within duration X.

ZTE, NEC proposed (N)PRACH enhancement within duration X is not needed

* ZTE mentioned the motivation to enhance NPRACH within duration X is to allow UE to send SR via PRACH. However, the introduction of duration X is mainly to extend UL transmission duration after GNSS expiration if UE does not finish its UL transmission, which avoids additional access procedures. If UE has nothing to transmit, it is preferred to let UE go back to IDLE instead of keep in connected mode, since large number of closed loop TA corrections are needed to maintain the UL synchronization. In this case, using PRACH to send SR within duration X is not necessary. ZTE proposed the enhancement on NPRACH is not needed especially in maintenance phase.
* NEC mentioned no need to further discuss the issue of accumulated timing error in for IoT NTN Rel18
* Nokia, NSB mentioned If the uplink transmission is allowed in a duration X after expiry of the original GNSS validity duration, the UE cannot perform uplink pre-compensation based on UE location unless the duration X also extends the GNSS validity duration and the eNB can provide Timing Advance Commands to the UE during the duration X, if the UE is not allowed to perform uplink pre-compensation based on the old UE location where the eNB can trigger a new aperiodic GNSS measurement gap if needed. The eNB, or alternatively specification, must decide if the UE’s old GNSS location can be used for uplink transmit pre-compensation during the extension X. Nokia, NSB proposed RAN1 to discuss whether option 1 (reuse GNSS) or 2 (rely on TAC) for TA adjustment during extended duration is used or can be configured by the eNB. To the moderator understanding, it should be captured in RAN2 stage 2 TS36.300 on the issue related to validity of GNSS, RAN1 just needs to define how to calculate within duration X, which has already been captured in TS 36.211.
* Apple mentioned during duration X where UL transmission is allowed, UE considers the UL synchronization is valid and there is no need to extend the GNSS validity duration and no special handling is needed to determine the timing advance within duration X.
* Qualcomm observed according to current specifications, any time a UE transmits a NPRACH, it uses a value of , if a considerable amount of time has passed since the last GNSS position fix the accuracy of becomes progressively worse over time, although the eNB can progressively correct (by issuing TA commands) the timing error due to a stale UE location, this correction is not applied when transmitting NPRACH (which currently uses . This may cause the timing error to go beyond the NPRACH correction capability.
* Nordic proposed in RRC Connected mode, the accumulated timing advance , obtained via closed loop TACs, should always apply to (N)PRACH also, instead of setting
1. **Others:**

Contributing companies mentioned on related issues/enhancements:

* NEC mentioned Closed-loop frequency correction mechanism is not needed for IoT NTN for Rel18.
* Nokia, NSB mentioned if the UE transmits using segments during the duration X, the UE will not monitor for Timing Advance Commands, to adjust the timing advance per segment, during the segmented transmission and proposed If the UE is not allowed to use the old UE location during duration X, RAN1 needs to define whether 1) eNB cannot schedule segmented transmissions or 2) provides a TAC per segment prior to starting the repetition period.
* Samsung mentioned to support closed loop correction for pre-compensated frequency offset, e.g., absolute frequency command and/or frequency adjustment command can be considered.

Moderator View: RAN2 123 agreed if there is neither network aperiodically trigger nor network configuration of UE autonomously GNSS measurement, UE moves to RRC\_IDLE after GNSS becomes invalid. It’s FFS how to decide GNSS valid or invalid considering duration X and Y. RAN2 can further discuss GNSS valid or invalid considering duration X and Y, RAN1 just needs to define how to calculate within duration X, which has already been captured in TS 36.211. For the length/configuration of duration X/Y and (N)PRACH enhancement within duration X (discussed in Issue 4.4), RAN1 can align understanding first. Given that it is the maintenance meeting in R18 that RAN1 should deal with the more critical issues in priority, the following proposals are made

## First Round Discussion

**Initial Proposal 1-1:**

**From RAN1 perspective, *the start time of duration X should be at the point where original GNSS validity duration expires***

* ***when timeAlignmentTimer is not infinity, down select:***
	+ ***Alt-1:*** ***the end of X should be at the point where timeAlignmentTimer expires and the timeAlignmentTimer is reset every time when MAC CE TAC is received***
	+ ***Alt-2:*** ***the end of X should be at the point where*** ***new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to timeAlignmentTimer every time when MAC CE TAC is received***
* ***when timeAlignmentTimer is infinity, down select:***
	+ ***Alt-3: X is equal to a single configured value Y without extension when MAC CE TAC is received***
	+ ***Alt-4: the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to Y every time when MAC CE TAC is received***

**Initial Conclusion 1-2:**

**From RAN1 perspective, *the latest GNSS position fix obtained before duration X is triggered, can be utilized for calculating for uplink transmission within duration X.***

***Note:*** ***no change to existing RAN1 spec***

Companies are encouraged to provide comments within the following table:

|  |  |  |
| --- | --- | --- |
| Companies | Alt | Comments |
| Huawei, HiSilicon | Alt 1 and Alt 4 for proposal 1-1Support conclusion 1-2 | When TAT is not infinite, there is no need to initiate a new timer as the existing TAT can be reused. If TAT is infinite, then a new timer should be used to keep the same behavior as TAT except for the value of timer.  |
| Nokia, NSB |  | Proposal 1-1: All the listed alternatives are not work well. There may be one or multiple UL extension X based on network evaluation of the candidate time error. There should be no automatic reset of UL extension timer when receiving TAC as network may configure TA for some transmission but not to extend the UL extension X considering the e.g. accumulated time error. The MAC CE TAC is for time adjustment, which is not for extension of X. while the TAT is configured by RRC, which can not be changed at least for the CP only solution. We propose RAN1 to discuss the case that MAC CE indicating TAC can be allowed with or without further extension of X.Proposal 1-2: No support. From RAN1 perspective, the UL timing should be important. Only when the original GNSS position fix is with low error considering UE movement, it can be used for calculation of UE specific TA. Or RAN1 should consider other way for the procedure, e.g. network transmit closed loop TA to UE.Additionally, from this initial conclusion, it means UE should support network triggered GNSS measurement at first. |
| Qualcomm | Alt-4 | For Alt-1 vs Alt-2, it is unclear what is the difference in behavior (it seems the status of *ULTransimissionExtentionTimer* and *timeAlignmentTimer* would always be the same)For the case of TAT=infinity, we think Alt-4 is the appropriate solution since it will have the same behavior as when TAT is not infinity. |
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## Summary of First Round Discussion

Initial Proposal 1-1

Huawei, HiSilicon, support Alt.1.

support Alt.2.

support Alt.3.

Huawei, HiSilicon, Qualcomm, support Alt.4.

* Huawei, HiSilicon mentioned When TAT is not infinite, there is no need to initiate a new timer as the existing TAT can be reused. If TAT is infinite, then a new timer should be used to keep the same behavior as TAT except for the value of timer.
* Nokia, NSB mentioned there may be one or multiple UL extension X based on network evaluation of the candidate time error. There should be no automatic reset of UL extension timer when receiving TAC as network may configure TA for some transmission but not to extend the UL extension X considering the e.g. accumulated time error. RAN1 to discuss the case that MAC CE indicating TAC can be allowed with or without further extension of X. To the moderator understanding, RAN1 has agreed the feature of “UL transmission after original validity duration expires with duration X” can be enabled/disabled by network via RRC signalling, when the feature is disabled, MAC TAC can be allowed without further extension of X.
* Qualcomm mentioned the difference in behavior, Alt-4 is the appropriate solution since it will have the same behavior as when TAT is not infinity. To the moderator understanding, the difference between Alt 1and Alt 2 is whether there is a need to initiate a new timer as the existing TAT can be reused.
* Ericsson mentioned Note of the proposal should be sufficient.
* CATT mentioned GNSS validity and TA validity are different concepts
* CMCC mentioned UE still can perform UL transmission in the time period of duration X, while the remaining GNSS validity duration keeps unchanged and becomes invalid when original GNSS validity duration expires.

Initial Proposal 1-2

Huawei, HiSilicon, support Initial Proposal 1-2.

Nokia, NSB, not support Initial Proposal 1-2.

* Nokia, NSB mentioned only when the original GNSS position fix is with low error considering UE movement, it can be used for calculation of UE specific TA. Or RAN1 should consider other way for the procedure, e.g. network transmit closed loop TA to UE.

Moderator View: On Initial Proposal 1-1, RAN1 can further discuss to down select.On Initial Proposal 1-2, the moderator’s intention is to clarify can still be calculated with the GNSS within duration X**.**

## Second Round Discussion

***Second Round Proposal 1-1:***

**From RAN1 perspective, *the start time of duration X should be at the point where original GNSS validity duration expires***

* ***when timeAlignmentTimer is not infinity, down select:***
	+ ***Alt-1:*** ***the end of X should be at the point where timeAlignmentTimer expires and the timeAlignmentTimer is reset every time when MAC CE TAC is received***
	+ ***Alt-2:*** ***the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to timeAlignmentTimer every time when MAC CE TAC is received***
* ***when timeAlignmentTimer is infinity, down select:***
	+ ***Alt-3: X is equal to a single configured value Y without extension when MAC CE TAC is received***
	+ ***Alt-4: the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to Y every time when MAC CE TAC is received***

***Second Round* Conclusion *1-2:***

**From RAN1 perspective, *the latest GNSS position fix obtained before duration X is triggered, can be utilized for calculating for uplink transmission within duration X.***

***Note:*** ***no change to existing RAN1 spec***

Companies are encouraged to provide comments within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Nokia, NSB | Proposal 1-1: as we discussed in the offline/online session, if MAC CE TAC always also indicate of new UL extension duration besides the original meaning of TA command, then the UL transmission extension duration may be endless and can not be stopped considering the TAC from eNB on time adjustment or eNB even can not send TAC to UE for time adjustment. And in this case, there may be no autonomous GNSS measurement with the endless UL transmission extension duration. That is not what IoT NTN want.To avoid this, we propose to add one more alternative for discussion/down selection for MAC CE TAC to explicitly indicate whether only for TAC or also for new UL transmission extension, as below:“**From RAN1 perspective, *the start time of duration X should be at the point where original GNSS validity duration expires*** * ***when timeAlignmentTimer is not infinity, down select:***
	+ ***Alt-1:*** ***the end of X should be at the point where timeAlignmentTimer expires and the timeAlignmentTimer is reset every time when MAC CE TAC is received***
	+ ***Alt-2:*** ***the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to timeAlignmentTimer every time when MAC CE TAC is received***
	+ ***Alt-5: the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and 1) ULTransimissionExtentionTimer is reset with length equal to timeAlignmentTimer every time when MAC CE TAC is received if MAC CE TAC also indicate new UL extension, or 2) ULTransimissionExtentionTimer is not reset if MAC CE TAC indicate no new UL extension***
* ***when timeAlignmentTimer is infinity, down select:***
	+ ***Alt-3: X is equal to a single configured value Y without extension when MAC CE TAC is received***
	+ ***Alt-4: the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to Y every time when MAC CE TAC is received***
	+ ***Alt-6: the end of X should be at the point where new timer ULTransimissionExtentionTimer expires and 1) ULTransimissionExtentionTimer is reset with length equal to Y every time when MAC CE TAC is received if MAC CE TAC also indicate new UL extension, or 2) ULTransimissionExtentionTimer is not reset if MAC CE TAC indicate no new UL extension*** ”

Proposal 1-2: No support. From RAN1 perspective, the UL timing should be important. Only when the original GNSS position fix is with low error considering UE movement, it can be used for calculation of UE specific TA. Or RAN1 should consider other way for the procedure, e.g. network transmit closed loop TA to UE to adjust the TA but with UE specific TA as the value at the original GNSS validity duration expire but not update more.Additionally, from this initial conclusion, it means UE should support network triggered GNSS measurement at first. |
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# [Active] Issue #2: GNSS measurement gap/timer

**Agreement (RAN1 111)**

For GNSS measurement in RRC connected, if eNB aperiodically triggers connected UE to make GNSS measurement, UE can re-acquire GNSS position fix with a gap

* FFS details of gap configuration

The UE may re-acquire GNSS autonomously (when configured by the network) if UE does not receive eNB trigger to make GNSS measurement

* FFS based on configured timing

**Agreement (RAN1 112)**

On the length of GNSS measurement gap, which is aperiodically triggered by eNB, the gap duration should be equal to or larger than the latest UE reported GNSS position fix time duration.

FFS: whether the gap duration is configured by eNB, or the gap duration is equal to the latest reported GNSS position fix time duration.

**Agreement (RAN1 112)**

On when the GNSS measurement gap starts, which is aperiodically triggered by eNB with MAC CE, RAN1 can down select one of the following alternatives:

* Alt 1: the start time should be at n+ X, where n is the end of MAC CE receiving subframe/slot
* FFS: details of X, e.g. predefined value or configured value
* Alt 2: the start time should be based on the current GNSS validity duration with delay or without delay

**Agreement (RAN1 112bis)**

For the GNSS measurement gap aperiodically triggered with MAC CE, the duration for the GNSS measurement gap can be configured by eNB.

* The gap duration is equal to the latest reported GNSS position fix time duration for measurement when the duration for GNSS measurement gap is not included in the configuration by eNB.

**Agreement (RAN1 112bis)**

On when the aperiodic GNSS measurement gap starts, which is aperiodically triggered by eNB with MAC CE, the start time should be at n+ X, where n is the end of MAC CE receiving subframe/slot

* FFS: details of X, e.g. predefined value or configured value, considering HARQ feedback for the MAC CE, etc

**Agreement (RAN1 113)**

The UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration before the UE reacquires GNSS successfully.

FFS: UE’s behavior within the duration after UE reacquires GNSS successfully to the end of the gap if the UE reacquires GNSS successfully before the end of the gap.

**Agreement (RAN1 113)**

For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, down select one of the alternatives for the start time of the gap:

* Alt 1: should be at n+ X, where n is the end of MAC CE receiving subframe/slot and X>= 12ms for NB-IoT, X>= 3ms for eMTC
* Note: X is one value regardless of HARQ feedback enabled or disabled for the MAC CE
* FFS: details, e.g. X is predefined value or configured value
* Alt 2: should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled and X1>= 12ms for NB-IoT, X1>= 3ms for eMTC, or should be at p+ X2, where p is the end of HARQ feedback transmission subframe/slot when HARQ feedback for the MAC CE is enabled
* FFS: details, e.g. X1 and X2 are predefined value or configured value, including whether X1 and X2 can be the same
* Alt3: should be at p+ X, where p is the end of HARQ feedback transmission subframe/slot, where HARQ feedback for the MAC CE is always enabled
* FFS: details, e.g. X is predefined value or configured value

**Agreement (RAN1 114)**

For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at

* n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled and X1>= 12ms for NB-IoT, X1>= 3ms for eMTC,
* or should be at p+ X2, where p is the end of HARQ feedback transmission subframe/slot when HARQ feedback for the MAC CE is enabled
	+ X1 is predefined values, where X1=12ms for NB-IoT, and FFS X1 for eMTC
	+ FFS: X2 is predefined value or configured value.

**Agreement (RAN1 114)**

Network can configure the length for GNSS measurement gap via a 4-bit field with component values [1,2,3,4,5,6,7,13,19,25,31] second.

* FFS: other component values
* Note: RAN2 can further discuss whether separate configurations are needed for GNSS measurement gap and GNSS measurement timer, and whether the configuration is by RRC or MAC CE

**Agreement (RAN1 114)**

For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled.

* X1=12ms for NB-IoT
* X1=6ms for eMTC

**Agreement (RAN1 114)**

The UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent.

* CBRA (PRACH) can be sent at least to request UL resource to report the remaining GNSS validity duration.

Note1: The CBRA (PRACH) can only be sent within the duration after UE reacquires GNSS successfully to the end of the gap.

Note2: Whether CBRA (PRACH) is sent is up to UE implementation.

Note3: no change to existing CBRA procedures

FFS: whether other RA procedure is needed.

**Agreement (RAN1 114bis)**

For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at p+ X2, where p is the end of HARQ feedback transmission subframe/slot when HARQ feedback for the MAC CE is enabled and X2 is a predefined value, down select

* Alt- A: X2 = 1ms
* Alt- B: X2 = 2ms
* Alt- C: X2 = 3ms
* Alt- E: X2 = 1ms for NB-IoT, X2 = 4ms for eMTC

**Agreement (RAN1 114bis)**

For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at p+ X2, where p is the end of HARQ feedback transmission subframe/slot when HARQ feedback for the MAC CE is enabled and X2 is predefined value, where X2 = 2ms.

**Agreement (RAN1 111)**

For GNSS measurement in RRC connected, if eNB aperiodically triggers connected UE to make GNSS measurement, UE can re-acquire GNSS position fix with a gap

* FFS details of gap configuration

The UE may re-acquire GNSS autonomously (when configured by the network) if UE does not receive eNB trigger to make GNSS measurement

* FFS based on configured timing

**Agreement (RAN1 113)**

For NB-IoT and eMTC, at least for the case where the network configuration does not include a periodicity (if supported), for autonomous GNSS re-acquisition, the UE may re-acquire GNSS autonomously during GNSS measurement timer, the start time of the autonomous GNSS measurement timer is based on the original GNSS validity duration.

* FFS: additional delay and details of delay (if any), e.g. delay can be zero or can be equal to/larger than the duration X where UL transmission can be allowed after original GNSS validity duration expires without GNSS re-acquisition.
* Note1: Autonomous GNSS re-acquisition mechanism is enabled or disabled by network.
* Note2: The length of GNSS measurement timer can be configured by network and the length of GNSS measurement timer is equal to the latest reported GNSS position fix time duration for measurement when the length of GNSS measurement timer is not configured
* Note3: The autonomous GNSS re-acquisition can be periodic in certain conditions without further spec impact

**Agreement (RAN1 114)**

For autonomous GNSS timer, the start time of the autonomous GNSS measurement timer is where the original GNSS validity duration expires, and the duration X (if any) expires.

Note (as already agreed): The duration X is where UL transmission can be allowed after original GNSS validity duration expires without GNSS re-acquisition.

**Agreement (RAN1 114)**

Network can configure the length for GNSS measurement timer via a 4-bit field with component values [1,2,3,4,5,6,7,13,19,25,31] second.

* FFS: other component values
* Note: RAN2 can further discuss whether separate configurations are needed for GNSS measurement gap and GNSS measurement timer

## Company contributing views

|  |  |
| --- | --- |
| Contribution | Observation/Proposals |
| Huawei, HiSilicon | Observation 1: eNB is not able to trigger CFRA for UE to indicate early complete of GNSS position fix measurement gap. |
| Spreadtrum | Proposal 2: The UE may re-acquire GNSS autonomously (when configured by the network) in the GNSS measurement timer, if UE does not receive eNB trigger to make GNSS measurement within duration T, where T starts at the point where latest remaining GNSS validity duration is reported to the end of UL transmission extension duration expires (if applied). |
| ZTE | Proposal 3: eNB trigger to make GNSS measurement does not impact the autonomous GNSS reacquisition after the GNSS measurement gap. |
| Nokia, NSB | Observation 1: Based on the Random Access procedure accounting for NTN propagation delay it is clear when the UE shall monitor the PDCCH for a response to the PRACH.Proposal 1: The GNSS measurement gap / autonomous GNSS measurement timer ends after the UE starts the Random Access Response Window for a CBRA procedure if the RAR window started before the end of the original gap/timer.Proposal 7: The UE has to support receiving the aperiodic trigger for a GNSS measurement gap if the UE supports the autonomous GNSS measurement.Proposal 9: The GNSS measurement gap range do not require additional values.Proposal 10: The GNSS measurement timer range do not require additional values.Proposal 11: The GNSS position fix time duration range do not require additional values |
| Samsung | Proposal 1: Autonomous GNSS re-acquisition should be triggered when both GNSS validity duration and timerAlignmentTimer are expired.Proposal 2: GNSS measurement timer can have the same value as GNSS measurement gap. And, GNSS measurement gap can be configured by UE specific RRC signaling. |
| Ericsson | Proposal 3: If gaps configured for GNSS measurement and mobility measurements at least partially overlap in time, UE shall suspend the gaps configured for mobility measurement and prioritize the use of GNSS gaps. |
| Nordic Semiconductor ASA | Proposal 2: Agree on the conclusion to say that MAC-CE trigger by the eNB will not impact the autonomous GNSS re-acquisition by the UE when it takes place after the triggered measurement gap. Alternatively, agree on Second Round Proposal 3 from R1-2310299. |

RAN1 has agreed on the procedures of the GNSS measurement gap/timer and the UE behavior during the GNSS measurement gap. In this meeting, contributing companies further discuss on GNSS measurement gap/timer related issues.

1. ***The start of GNSS measurement gap when HARQ feedback for the MAC CE is disabled***

It has been agreed that For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled where X1=12ms for NB-IoT and X1=6ms for eMTC.

* Huawei, HiSilicon mentioned to update with X1=5ms for eMTC.
1. ***whether other RA procedure is needed***

It has been agreed that The UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration before the UE reacquires GNSS successfully and The UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent. Contributing companies proposed observations and proposals on whether CFRA is needed.

Huawei, HiSilicon preferred no CFRA can be sent within the gap.

* Huawei, HiSilicon mentioned eNB is not able to trigger CFRA for UE to indicate early complete of GNSS position fix measurement gap.
1. ***Relationship of GNSS measurement gap and timer***

The issue is to clarify the relationship of GNSS measurement gap and timer. If UE has a long connection time, and there is a GNSS measurement trigger, after the GNSS measurement is done, the previous GNSS measurement trigger will not impact following GNSS measurement timer as depicted in following figure 2-1, where the GNSS measurement timer can still be activated.



Fig.2-1 the start time of GNSS measurement gap

Spreadtrum, ZTE, Nordic proposed eNB trigger to make GNSS measurement does not impact the autonomous GNSS reacquisition after the GNSS measurement gap.

* Spreadtrum mentioned The UE may re-acquire GNSS autonomously (when configured by the network) in the GNSS measurement timer, if UE does not receive eNB trigger to make GNSS measurement within duration T, where T starts at the point where latest remaining GNSS validity duration is reported to the end of UL transmission extension duration expires (if applied).
* Nokia, NSB proposed the UE has to support receiving the aperiodic trigger for a GNSS measurement gap if the UE supports the autonomous GNSS measurement.
1. ***Others***
* Nokia, NSB mentioned based on the Random Access procedure accounting for NTN propagation delay it is clear when the UE shall monitor the PDCCH for a response to the PRACH and proposed the GNSS measurement gap / autonomous GNSS measurement timer ends after the UE starts the Random Access Response Window for a CBRA procedure if the RAR window started before the end of the original gap/timer. To the moderator understanding, RAN2 has agreed in RAN2 123bis “The following update in NOTE in Stage 2 running CR is agreed: NOTE: The AS operations (e.g. RLM related timers, dataInactivityTimer, CHO execution, neighbour cell measurement, **RACH**, SR, and BSR) are suspended when UE is performing GNSS measurement during GNSS measurement gap and resumed when the GNSS measurement is finished”.
* Samsung mentioned autonomous GNSS re-acquisition should be triggered when both GNSS validity duration and timerAlignmentTimer are expired. To the moderator understanding, this is associated with issue 1, RAN1 can discuss issue 1 first. Samsung further proposed GNSS measurement timer can have the same value as GNSS measurement gap and GNSS measurement gap can be configured by UE specific RRC signaling. RAN2 123bis has agreed for both network-triggered and UE-autonomous Measurement Gap Length Configuration: Use MAC CE (with 1 bit indication to differentiate the two cases) (FFS if a RRC configuration is needed for NW trigger case).
* Ericsson proposed If gaps configured for GNSS measurement and mobility measurements at least partially overlap in time, UE shall suspend the gaps configured for mobility measurement and prioritize the use of GNSS gaps. To the moderator understanding, this is agreed in RAN4, no need to further discuss in RAN1.

Moderator View: On when the GNSS measurement gap starts, as contributed companies mentioned, the gap triggered by eNB with MAC CE should be started at n+13 for NB-IoT and n+6 for eMTC, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled as depicted in following figure 2-2 to align with legacy delay. On the relationship of timer and gap, eNB trigger with MAC CE to make GNSS measurement in GNSS measurement gap should not impact the autonomous GNSS reacquisition after the GNSS measurement gap. On the configuration of GNSS measurement gap and whether CFRA can be sent within the gap, RAN1 can wait for RAN2 progress.



Fig.2-2 the start time of GNSS measurement gap

## First Round Discussion

***Initial Proposal 2-1:***

***Modify X1 value of RAN1#114 agreement on start time of GNSS measurement gap as follows:***

***For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled***

* ***X1=12ms for NB-IoT***
* ***X1=5~~6~~ms for eMTC***

***Initial Proposal 2-2:***

***If UE supports both aperiodic GNSS measurement gap and autonomous GNSS measurement timer, eNB trigger with MAC CE to make GNSS measurement in GNSS measurement gap does not impact the autonomous GNSS reacquisition after the GNSS measurement gap.***

Companies are encouraged to provide comments within the following table:

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| --- | --- |
| Companies | Comments |
| Huawei, HiSilicon | Support proposal 2-1Not support proposal 2-2, it reverts the early agreement. Maybe we should discuss the following proposal in the FLS in RAN1#114bis. ***Initial Proposal 3:******The UE may re-acquire GNSS autonomously (when configured by the network) in the GNSS measurement timer, if UE does not receive eNB trigger to make GNSS measurement within duration T, where T is latest reported remaining GNSS validity durationplus UL transmission extension duration.***  |
| Nokia, NSB | Proposal 2-1: OK.Proposal 2-2: No. Based on RAN1 agreement, if UE support GNSS re-acquisition, to guarantee UL synchronization with detection from eNb, when eNB trigger GNSS measurement, UE should do aperiodic GNSS measurement. Only when eNB has not triggered aperiodic GNSS measurement, to save overhead of GNSS measurement triggering, there can be autonomous measurement, i.e. the autonomous GNSS measurement depends on whether eNB triggering aperiodic GNSS measurement.This is the logic when RAN1 discuss that agreement in RAN1 #111. |
| Qualcomm | For 2-1, we would like to discuss it jointly with the TP in 4.1. We agree the timeline should be n+13 / n+6 for eMTC / NBIOT respectively, where n is the last SF carrying the MAC-CE. The current text is ambiguous (does “end” refer to the end of the subframe, or the last subframe in which it is received)Could we clarify the agreement as follows:***For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1+1, where n is the last subframe carrying the MAC CE ~~receiving subframe/slot~~ when HARQ feedback for the MAC CE is disabled*** * ***X1=12ms for NB-IoT***
* ***X1=5~~6~~ms for eMTC***
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## Summary of First Round Discussion

Initial Proposal 2-1

Huawei, HiSilicon, Nokia, NSB support.

* Qualcomm mentioned to agree the timeline should be n+13 / n+6 for eMTC / NBIOT respectively, where n is the last SF carrying the MAC-CE and to clarify “end” refer to the end of the subframe, or the last subframe in which it is received).
* Ericsson mentioned Note of the proposal should be sufficient.
* CATT mentioned GNSS validity and TA validity are different concepts
* CMCC mentioned UE still can perform UL transmission in the time period of duration X, while the remaining GNSS validity duration keeps unchanged and becomes invalid when original GNSS validity duration expires.

Initial Proposal 2-2

* Huawei, HiSilicon mentioned to discuss the discuss the proposal in the FLS in RAN1#114bis.
* Nokia, NSB mentioned if UE support GNSS re-acquisition, to guarantee UL synchronization with detection from eNb, when eNB trigger GNSS measurement, UE should do aperiodic GNSS measurement. Only when eNB has not triggered aperiodic GNSS measurement, to save overhead of GNSS measurement triggering, there can be autonomous measurement, i.e. the autonomous GNSS measurement depends on whether eNB triggering aperiodic GNSS measurement.

Moderator View: On Initial Proposal 2-2, RAN1should have consensus on eNB trigger with MAC CE to make GNSS measurement in GNSS measurement gap should not impact the autonomous GNSS reacquisition after the GNSS measurement gap.

## Second Round Discussion

***Second Round Proposal 2-1:***

***Modify X1 value of RAN1#114 agreement on start time of GNSS measurement gap as follows:***

***For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled***

* ***X1=12ms for NB-IoT***
* ***X1=5~~6~~ms for eMTC***

***Second Round* Proposal *2-2:***

**The UE may re-acquire GNSS autonomously (when configured by the network) in the GNSS measurement timer, if UE does not receive eNB trigger to make GNSS measurement within duration T, where T is latest reported remaining GNSS validity duration plus UL transmission extension duration X (if any).**

Companies are encouraged to provide comments within the following table:

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| Companies | Comments |
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# [Active] Issue #3: Success/Failure of GNSS measurement

**RAN2-116bis**

UE need to have a valid GNSS fix before going to connected. RAN2 assumes that the UE may need to re-acquire the GNSS fix right before establishing the connection (regardless if previously valid or not), if needed to avoid interruption during the connection.

When the GNSS fix becomes outdated in RRC\_CONNECTED mode, the UE goes to IDLE mode.

**Agreement (RAN1 112):**

The following alternatives can be considered to inform eNB the success of GNSS measurement at UE side after GNSS measurement in RRC connected.

* Alt-1: The UE will report the new GNSS validity duration
* Alt-2: The reception of any UL transmission from the UE at eNB after the GNSS measurement

**Agreement (RAN1 114)**

From RAN1 perspective, after autonomous GNSS measurement timer expires if UE failed to re-acquire GNSS position fix within the autonomous GNSS measurement timer UE goes to IDLE mode.

**Agreement (RAN1 114)**

From RAN1 perspective, for the aperiodic GNSS measurement gap triggered by eNB with MAC CE, down select one of the alternatives for the failure of GNSS measurement:

* Alt-1: UE goes to IDLE mode after the end of GNSS measurement gap if UE failed to re-acquire GNSS position fix within GNSS measurement gap.

**Agreement (RAN1 114)**

In RRC connected, every time after successful GNSS measurement, UE reports the new remaining GNSS validity duration.

FFS: Whether UE should report the new remaining GNSS validity duration within a duration D.

**RAN2-121bis**

UE can stay in RRC\_CONNECTED state when current GNSS position becomes out-of-date if the UE enters a GNSS measurement gap. FFS whether the new GNSS measurement shall be started before, upon or after the current GNSS validity duration expiry

**RAN2-122**

The UE triggers GNSS measurement reporting every time upon completing the GNSS fix operation.

## 3.1 Company contributing views

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| Contribution | Observation/Proposals |
| Huawei, HiSilicon | Proposal 3: The remaining GNSS validity duration can be updated by UE before the next GNSS measurement. |
| Xiaomi | Proposal 2: UE can report the remaining GNSS validity duration based on the eNB’s grant after successful GNSS measurement. |
| Nokia, NSB | Observation 7: The value of N\_TA is not clear after a UE has completed the GNSS measurement successfully.Proposal 6: RAN1 to discuss whether the UE after a successful GNSS measurement gap/autonomous GNSS timer either performs the Random Access procedure or reuses the previous N\_TA, when the new UE position is similar to the previous UE position.Proposal 8: There is no need for a requirement defining UE reports the new remaining GNSS validity duration within a duration D. |
| Nordic Semiconductor ASA | Proposal 3: In RRC Connected mode, the accumulated timing advance , obtained via closed loop TACs, should always apply to (N)PRACH also, instead of setting  |

In RAN1 #114, it has been agreed that In RRC connected, every time after successful GNSS measurement, UE reports the new remaining GNSS validity duration. Besides, from RAN1 perspective, after autonomous GNSS measurement timer expires if UE failed to re-acquire GNSS position fix within the autonomous GNSS measurement timer UE goes to IDLE mode and for the aperiodic GNSS measurement gap triggered by eNB with MAC CE, UE goes to IDLE mode after the end of GNSS measurement gap if UE failed to re-acquire GNSS position fix within GNSS measurement gap.

1. ***Need of duration D***

Some contributing companies provided observations and proposals for success of GNSS measurement on duration D and others.

Xiaomi, Nokia, NSB, Ericsson preferred there is no need to introduce a duration D.

* Xiaomi mentioned UE can also report the remaining GNSS validity duration based on the eNB’s grant outside the GNSS measurement gap. It seems not necessary to define the duration D. Xiaomi further proposed UE can report the remaining GNSS validity duration based on the eNB’s grant after successful GNSS measurement.
1. ***Others***
* Huawei, HiSilicon mentioned UE can perform autonomous GNSS measurement in C-DRX inactive period without starting autonomous GNSS timer. UE should report remaining GNSS measurement indicating the success of GNSS position fix after the UE enter into active mode.
* Nokia, NSB mentioned the value of N\_TA is not clear after a UE has completed the GNSS measurement successfully and proposed RAN1 to discuss whether the UE after a successful GNSS measurement gap/autonomous GNSS timer either performs the Random Access procedure or reuses the previous N\_TA, when the new UE position is similar to the previous UE position.
* Nordic proposed the accumulated timing advance term should be reset, i.e., to set after a new GNSS position fix is obtained in RRC Connected mode.

Moderator View: RAN2-122 has agreed that the UE triggers GNSS measurement reporting every time upon completing the GNSS fix operation, which also be applicable to GNSS measurement in C-DRX inactive period. For the duration D, RAN2 endorsed running CR R2-2308944 has captured as clause 5.yy Remaining GNSS measurement validity duration reportion, RAN2 can further discuss if needed. For resets after GNSS measurement, in the moderator understanding, the mobility of satellite is more obvious than UE, since there is no need to resets for SIB31 updates, UE should not reset for GNSS measurement.

## 3.2 First Round Discussion

***FL recommendation 3***

**No need for further discussion in RAN1 in *NTN-IoT R18* on:**

* **reporting remaining GNSS validity duration after successful GNSS measurement in C-DRX inactive period**
* **introducing a duration D after the end of aperiodic GNSS measurement gap or after the end of autonomous GNSS measurement timer**
* ***resetting after GNSS measurement*.**

**Note: RAN2 can further discuss if needed.**

Companies are encouraged to provide comments within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Huawei, HiSilicon | For the first bullet, we think it should be clarified whether the autonomous GNSS measurement in C-DRX is covered in the following agreement in RAN1#114, as the autonomous GNSS measurement in C-DRX may not base on timer according to RAN2. AgreementIn RRC connected, every time after successful GNSS measurement, UE reports the new remaining GNSS validity duration.FFS: Whether UE should report the new remaining GNSS validity duration within a duration D.  |
| Nokia, NSB | We think it is ok to discuss first bullet in RAN2.But for third bullet, we propose to update to “whether ***resetting after GNSS measurement***” and discuss this in RAN1 as it is not RAN2 issue and RAN2 will not discuss this. |
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# 4 [Active] Issue #4: TPs

Several TPs are proposed by contributing companies.

## 4.1 TP for the start time of GNSS measurement gap

#### 4.1.1 Motivation

In R1-2310879, Huawei, HiSilicon proposed a TP in Appendix A, mentioned that the starting point of a measurement gap is counted from the starting point of last subframe carrying triggering MAC CE, which is one subframe early than the agreement in RAN1#114. To keep the same time budget for processing the triggering MAC CE, the starting point of measurement gap should be in subframe n+13 for NB-IoT.

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| --- |
| AgreementFor the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled * X1=12ms for NB-IoT
* X1=6ms for eMTC
 |

In R1-2311999, MediaTek proposed a TP in Appendix A, mentioned that the gap for legacy scheduling/activation time from NPDSCH to NPUSCH is 12ms, which means the NPUSCH starts in subframe n+13, where a NB-IoT UE receives a NPDSCH transmission ending in subframe n. For the start time of GNSS measurement gap of NB-IoT, to align with legacy scheduling/activation time, the UE shall assume the start of the measurement gap in subframe n+13, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe n with HARQ-ACK disable.

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| **TS 36.213 Clause16.6**If a NB-IoT UE receives a NPDSCH transmission ending in subframe *n,* and if the UE is not required to transmit a corresponding NPUSCH format 2, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+12*. (start monitor in n+13)**TS 36.213 Clause 16.1.2**For a timing advance command reception ending in DL subframe *n*, the corresponding adjustment of the uplink transmission timing shall apply from the first available NB-IoT uplink slot following the end of *n+12* DL subframe and the first available NB-IoT uplink slot is the first slot of a NPUSCH transmission*.* (apply in n+13)**TS 36.213 Clause 16.4.2**The UE shall upon detection of a NPDSCH transmission ending in NB-IoT subframe *n* intended for the UE and for which an ACK/NACK shall be provided, start, after the end of - DL subframe for FDD, () (start ACK/NACK in n+13) |

In R1-2312054, Qualcomm proposed a TP in Appendix A, mentioned that while the X1 numbers of 6 and 12 are consistent with the values for timing advance, there is a 1ms difference between both:

* For eMTC, the gap (in logical time and neglecting Koffset) is 5ms since there are 5ms between the end of subframe n and the beginning of subframe n+6.
* For NB-IoT the gap (in logical time) is 12ms, since the text states “following the end of”

The main reason why NB-IoT behavior is written in this way is that, for uplink Rel-13 NB-IoT there are no uplink subframes (and therefore everything is written in terms of “uplink slot after the end of a DL subframe”). The current specification for GNSS gap gives a 11ms gap for NB-IoT, which should be corrected.

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| **eMTC:**For a BL/CE UE, for a timing advance command received on subframe *n*, the corresponding adjustment of the uplink transmission timing shall apply for the uplink PUCCH/PUSCH/SRS transmissions in subframe *n+6+Koffset*.**NB-IoT:**For a timing advance command reception ending in DL subframe *n*, the corresponding adjustment of the uplink transmission timing shall apply from the first available NB-IoT uplink slot following the end of *n+12* DL subframe and the first available NB-IoT uplink slot is the first slot of a NPUSCH transmission*.* |

Moderator View: As contributed companies mentioned, in the endorsed editor CR R1-2310771, DL subframe *n* is the ending of MAC CE, to keep the same time delay/offset for processing the triggering MAC CE, the starting point of measurement gap should be in subframe n+13 for NB-IoT.

#### 4.1.2 Proposed draft TP

**Reason for change:**

In the endorsed CR R1-2310771 Clause 16.10, the starting point of a measurement gap is counted from the starting point of last subframe carrying triggering MAC CE, which is one subframe early than the agreement in RAN1#114. To keep the same time budget for processing the triggering MAC CE, the starting point of measurement gap should be in subframe n+13 for NB-IoT.

**Summary of change:**

Change the start of the measurement gap in subframe n+13 if UE shall not provide HARQ-ACK information for the NPDSCH carrying the triggering MAC CE.

**Consequence if not approved:**

The RAN1 agreement for GNSS measurement is not captured correctly in specification.

|  |
| --- |
| ========================= Start of TP #1 for TS 36.213 =========================< Unchanged parts are omitted >16.10 GNSS measurement gap related proceduresFor a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe *n*,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe *n*+13- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.============================= End of TP #1 for TS 36.213 ============================= |

#### 4.1.3 First Round Discussion

***Initial Proposal 4.1:***

***TP#1 in section 4.1.2 of R1-231XXXX is endorsed for TS36.213 Clause 16.10.***

Companies are encouraged to provide comments within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Huawei, HiSilicon | Support the TP |
| Nokia, NSB | OK |
| Qualcomm | OK |
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#### 4.1.4 Summary of First Round Discussion

The proposal has been discussed in the offline and GTW session with the following agreement:

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## 4.2 TP for UE behavior within the GNSS measurement gap

#### 4.2.1 Motivation

In R1-2310879, Huawei, HiSilicon proposed a TP in Appendix A, mentioned that the transmission/reception of physical layer channels/signals during the GNSS measurement gap for IoT NTN during RRC connected should be specified for TS36.213. The RAN1 agreements illustrated below also impact the physical layer procedures and is not captured in both RAN1 (TS36.213 v18.0.0) and RAN2 (TS 36.331 v17.6.0, TS 36.321 v17.6.0) running CR as following:

|  |
| --- |
| **Agreement**The UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration before the UE reacquires GNSS successfully. FFS: UE’s behavior within the duration after UE reacquires GNSS successfully to the end of the gap if the UE reacquires GNSS successfully before the end of the gap.AgreementThe UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent.* CBRA (PRACH) can be sent at least to request UL resource to report the remaining GNSS validity duration.

Note1: The CBRA (PRACH) can only be sent within the duration after UE reacquires GNSS successfully to the end of the gap.Note2: Whether CBRA (PRACH) is sent is up to UE implementation.Note3: no change to existing CBRA procedures* FFS: whether other RA procedure is needed.
 |

In R1-2309980, MediaTek proposed a TP in Appendix A, mentioned that RAN1 has agreed the UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent. The agreed behavior and condition on where the UE is not required to monitor N/MPDCCH should be captured in TS 36.213 at Clause 16.6. Then the relevant RAN2 and RAN4 specification can refer to RAN1 specification.

Moderator View: As contributed companies mentioned, RAN1 has agreed UE’s behavior within the GNSS measurement gap and the behaviors should be captured in RAN1 spec.

#### 4.2.2 Proposed draft TP

**Reason for change:**

RAN1 has made agreement as following on UE’s behavior within the GNSS measurement gap. RAN1 should capture related GNSS measurement gap procedures in TS 36.213

|  |
| --- |
| **Agreement**The UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration before the UE reacquires GNSS successfully. FFS: UE’s behavior within the duration after UE reacquires GNSS successfully to the end of the gap if the UE reacquires GNSS successfully before the end of the gap.AgreementThe UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent.* CBRA (PRACH) can be sent at least to request UL resource to report the remaining GNSS validity duration.

Note1: The CBRA (PRACH) can only be sent within the duration after UE reacquires GNSS successfully to the end of the gap.Note2: Whether CBRA (PRACH) is sent is up to UE implementation.Note3: no change to existing CBRA proceduresFFS: whether other RA procedure is needed. |

**Summary of change:**

The procedure of transmission/reception of physical layer channels/signals during the GNSS measurement gap for IoT NTN in TS36.213.

**Consequence if not approved:**

The RAN1 agreements for UE’s behaviors within the GNSS measurement gap are not captured in specification.

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| --- |
| ========================= Start of TP #2 for TS 36.213 =========================< Unchanged parts are omitted >**16.10 GNSS measurement gap related procedures**For a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe n+12- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.For a NB-IoT UE in a NTN serving cell, within the aperiodic GNSS measurement gap duration:- before the UE reacquires GNSS successfully, the UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration. - after the UE reacquires GNSS successfully, the UE is not required to monitor NPDCCH within the aperiodic GNSS measurement gap, except after a contention based Random Access is performed as specified in TS 36.321 [8].< Unchanged parts are omitted >**18 GNSS measurement gap related procedures for BL/CE UE**For a BL/CE UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a PDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the PDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe n+6- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the HARQ-ACK transmission for the HARQ process associated with the transport block in the PDSCH.For a BL/CE UE in a NTN serving cell, within the aperiodic GNSS measurement gap duration:- before the UE reacquires GNSS successfully, the UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration. - after the UE reacquires GNSS successfully, the UE is not required to monitor MPDCCH within the aperiodic GNSS measurement gap, except after a contention based Random Access is performed as specified in TS 36.321 [8].< Unchanged parts are omitted >============================= End of TP #2 for TS 36.213 ============================= |

#### 4.2.3 First Round Discussion

***Initial Proposal 4.2:***

***TP#2 in section 4.2.2 of R1-231XXXX is endorsed for TS36.213 Clause 16.10 and Clause 18.***

Companies are encouraged to provide comments within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Huawei, HiSilicon | Fine with the TP |
| Nokia, NSB | For second bullet, it should be changed to “aperiodic GNSS measurement gap duration” to have aligned description in the clause.For the second bullet, as UE has complete the GNSS measurement and begin the random access procedure, then it will be more clear to mention that the GNSS measurement gap will be end after the CBRA preamble transmission as following:“For a BL/CE UE in a NTN serving cell, within the aperiodic GNSS measurement gap duration:- before the UE reacquires GNSS successfully, the UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration. - after the UE reacquires GNSS successfully, the UE is not required to monitor MPDCCH within the aperiodic GNSS measurement gap duration, except GNSS measurement gap ends after a contention based Random Access is performed as specified in TS 36.321 [8]” |
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#### 4.2.4 Summary of First Round Discussion

The proposal has been discussed in the offline with some updates:

Moderator View: On the related TP, RAN1 can further discuss.

#### 4.2.5 Updated draft TP

**Reason for change:**

RAN1 has made agreement as following on UE’s behavior within the GNSS measurement gap. RAN1 should capture related GNSS measurement gap procedures in TS 36.213

|  |
| --- |
| **Agreement**The UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration before the UE reacquires GNSS successfully. FFS: UE’s behavior within the duration after UE reacquires GNSS successfully to the end of the gap if the UE reacquires GNSS successfully before the end of the gap.AgreementThe UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent.* CBRA (PRACH) can be sent at least to request UL resource to report the remaining GNSS validity duration.

Note1: The CBRA (PRACH) can only be sent within the duration after UE reacquires GNSS successfully to the end of the gap.Note2: Whether CBRA (PRACH) is sent is up to UE implementation.Note3: no change to existing CBRA proceduresFFS: whether other RA procedure is needed. |

**Summary of change:**

The procedure of transmission/reception of physical layer channels/signals during the GNSS measurement gap for IoT NTN in TS36.213.

**Consequence if not approved:**

The RAN1 agreements for UE’s behaviors within the GNSS measurement gap are not captured in specification.

|  |
| --- |
| ========================= Start of TP #2 for TS 36.213 =========================< Unchanged parts are omitted >**16.10 GNSS measurement gap related procedures**For a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe n+12- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.For a NB-IoT UE in a NTN serving cell, within the aperiodic GNSS measurement gap duration:- before the UE reacquires GNSS successfully, the UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration. - after the UE reacquires GNSS successfully, the UE is not required to monitor NPDCCH within the aperiodic GNSS measurement gap, except after a contention based Random Access is performed as specified in TS 36.321 [8].< Unchanged parts are omitted >**18 GNSS measurement gap related procedures for BL/CE UE**For a BL/CE UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a PDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the PDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe n+6- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the HARQ-ACK transmission for the HARQ process associated with the transport block in the PDSCH.For a BL/CE UE in a NTN serving cell, within the aperiodic GNSS measurement gap duration:- before the UE reacquires GNSS successfully, the UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration. - after the UE reacquires GNSS successfully, the UE is not required to monitor MPDCCH within the aperiodic GNSS measurement gap, except after a contention based Random Access is performed as specified in TS 36.321 [8].< Unchanged parts are omitted >============================= End of TP #2 for TS 36.213 ============================= |

#### 4.2.6 Second Round Discussion

***Second Round Proposal 4.2:***

***TP#2 in section 4.2.5 of R1-2312299 is endorsed for TS36.213 Clause 16.10 and Clause 18.***

Companies are encouraged to provide comments within the following table:

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| --- | --- |
| Companies | Comments |
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## 4.3 TP for distinguishing GNSS measurement gap and RRM measurement gap

#### 4.3.1 Motivation

In R1-2311181, Spreadtrum proposed a TP in Appendix A, mentioned that measurement gap for RRM and GNSS measurement gap need to be distinguished in the specification.

Moderator View: The titles of Clause 16.10 and Clause 18 are for GNSS measurement gap, the gap mentioned following should be GNSS measurement gap.

#### 4.3.2 Proposed draft TP

**Reason for change:**

Measurement gap for RRM and GNSS measurement gap need to be distinguished in the specification.

**Summary of change:**

Change measurement gap to GNSS measurement gap in clause16.10 and clause 18 in 36.213

**Consequence if not approved:**

Measurement gap for RRM and GNSS measurement gap cannot be distinguished in the specification.

|  |
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| ========================= Start of TP #3 for TS 36.213 =========================< Unchanged parts are omitted >16.10 GNSS measurement gap related proceduresFor a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe *n*,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the GNSS measurement gap in subframe *n*+12- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.< Unchanged parts are omitted >**18 GNSS measurement gap related procedures for BL/CE UE**For a BL/CE UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a PDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the PDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the GNSS measurement gap in subframe *n*+6- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the HARQ-ACK transmission for the HARQ process associated with the transport block in the PDSCH.< Unchanged parts are omitted >============================= End of TP #3 for TS 36.213 ============================= |

#### 4.3.3 First Round Discussion

***Initial Proposal 4.3:***

***TP#3 in section 4.3.2 of R1-231XXXX is endorsed for TS36.213 Clause 16.10 and Clause 18.***

Companies are encouraged to provide comments within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Huawei, HiSilicon | We do not think the change is necessary, as the whole clause of 16.10 and 18 are talking about GNSS measurement gap in the title of clause. |
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#### 4.3.4 Summary of First Round Discussion

The proposal has been discussed without consensus. As companies mentioned, GNSS measurement gap are in the title of clause.

## 4.4 TPs for the accumulated for (N)PRACH transmission with duration X

#### 4.4.1 Motivation

In R1-2312054, Qualcomm proposed TPs in Appendix A, Qualcomm observed according to current specifications, any time a UE transmits a NPRACH, it uses a value of , if a considerable amount of time has passed since the last GNSS position fix the accuracy of becomes progressively worse over time, although the eNB can progressively correct (by issuing TA commands) the timing error due to a stale UE location, this correction is not applied when transmitting NPRACH (which currently uses . This may cause the timing error to go beyond the NPRACH correction capability. Qualcomm mentioned that UE to also use the closed loop accumulated TA for NPRACH when the UE is configured with GNSS validity extension to mitigate issue for the timing error to go beyond the NPRACH correction capability.

Moderator View: The TPs are associated with Issue 1, RAN1 can first discuss on whether the TPs are needed.

#### 4.4.2 Proposed draft TPs

**Reason for change:**

To mitigate issue for the timing error to go beyond the NPRACH correction capability.

**Summary of change:**

UE to also use the closed loop accumulated TA for NPRACH when the UE is configured with GNSS validity extension.

**Consequence if not approved:**

The timing error due to a stale UE location may go beyond the NPRACH correction capability.

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| **============================== <TP2.1 36.211> ==================================**5.7.1 Time and frequency structure**<Unchanged parts are omitted>**The start of the random access preamble formats 0-3 shall be aligned with the start of the corresponding uplink subframe at the UE assuming  except if *GNSSExtensionByClosedLoop* is configured, in which case the accumulated is used. The random access preamble format 4 shall start  before the end of the UpPTS at the UE, where the UpPTS is referenced to the UE's uplink frame timing assuming.**<Unchanged parts are omitted>****================================= </TP2.1> ======================================****============================== <TP2.2 36.213> ==================================**4.2.3 Transmission timing adjustmentsUpon reception of a timing advance command or a timing adjustment indication for a TAG containing the primary cell or PSCell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS, and PRACH if higher layer parameter *GNSSExtensionByClosedLoop,* of the primary cell or PSCell based on the received timing advance command or a timing adjustment indication.**<Unchanged parts are omitted>**In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is not configured*,* an 11-bit timing advance command [8], *TA*, for a TAG indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 256 if the UE is configured with a SCG, and *TA* = 0, 1, 2, ..., 1282 otherwise, where an amount of the time alignment for the TAG is given by *NTA* = *TA* ×16. *NTA* is defined in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is configured*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ×16. In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format 6-0A/B if present [4], *TA*, for a TAG indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a given amount respectively.**<Unchanged parts are omitted>**16.1.2 Timing synchronizationUpon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH, and SR if configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, and NPRACH if configured with higher layer parameter *GNSSExtensionByClosedLoop,* based on the received timing advance command.The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16. The start timing of the random access preamble is specified in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is not configured*,* an 11-bit timing advance command [8], *TA*, indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA* = *TA* ×16. *NTA* is defined in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is configured*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ×16. In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format N0 if present [4], *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.**================================= </TP2.2> ======================================** |

#### 4.4.3 First Round Discussion

***Initial Proposal 4.4:***

***Companies are encouraged to comment on whether TPs in section 4.4.2 of R1-231XXXX are needed.***

Companies are encouraged to provide comments within the following table:

|  |  |  |
| --- | --- | --- |
| Companies | Yes/No | Comments |
| Huawei, HiSilicon |  | It depends on the conclusion on the third bullet of issue #3. |
| Nokia, NSB |  | We think RAN1 should firstly discuss whether GNSS validity extension can be extended before discuss this TP. And “higher layer parameter *GNSSExtensionByClosedLoop*” has not been agreed.For to reuse the close loop TA for PRACH, it should only be considered when the new UE location is not much different from the new UE location. If the new UE location is much different from the old UE location, then the old NTA can not be reused. |
| Qualcomm |  | Support the TP |
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#### 4.4.4 Summary of First Round Discussion

The proposal has been discussed offline without consensus.

Moderator View: On whether PRACH enhancements are needed and the related TP, RAN1 can further discuss.

#### 4.4.5 Updated draft TP

**Reason for change:**

To mitigate issue for the timing error to go beyond the NPRACH correction capability.

**Summary of change:**

UE to also use the closed loop accumulated TA for NPRACH when the UE is configured with GNSS validity extension.

**Consequence if not approved:**

The timing error due to a stale UE location may go beyond the NPRACH correction capability.

|  |
| --- |
| **============================== <TP2.1 36.211> ==================================**5.7.1 Time and frequency structure**<Unchanged parts are omitted>**The start of the random access preamble formats 0-3 shall be aligned with the start of the corresponding uplink subframe at the UE assuming  except if *GNSSExtensionByClosedLoop* is configured, in which case the accumulated is used. The random access preamble format 4 shall start  before the end of the UpPTS at the UE, where the UpPTS is referenced to the UE's uplink frame timing assuming.**<Unchanged parts are omitted>****================================= </TP2.1> ======================================****============================== <TP2.2 36.213> ==================================**4.2.3 Transmission timing adjustmentsUpon reception of a timing advance command or a timing adjustment indication for a TAG containing the primary cell or PSCell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS, and PRACH if higher layer parameter *GNSSExtensionByClosedLoop,* of the primary cell or PSCell based on the received timing advance command or a timing adjustment indication.**<Unchanged parts are omitted>**In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is not configured*,* an 11-bit timing advance command [8], *TA*, for a TAG indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 256 if the UE is configured with a SCG, and *TA* = 0, 1, 2, ..., 1282 otherwise, where an amount of the time alignment for the TAG is given by *NTA* = *TA* ×16. *NTA* is defined in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is configured*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ×16. In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format 6-0A/B if present [4], *TA*, for a TAG indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a given amount respectively.**<Unchanged parts are omitted>**16.1.2 Timing synchronizationUpon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH, and SR if configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, and NPRACH if configured with higher layer parameter *GNSSExtensionByClosedLoop,* based on the received timing advance command.The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16. The start timing of the random access preamble is specified in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is not configured*,* an 11-bit timing advance command [8], *TA*, indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA* = *TA* ×16. *NTA* is defined in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is configured*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ×16. In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format N0 if present [4], *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.**================================= </TP2.2> ======================================** |

#### 4.4.6 Second Round Discussion

***Second Round Proposal 4.2:***

***TPs in section 4.4.5 of R1-2312299 are endorsed for TS36.213 and TS 36.211.***

Companies are encouraged to provide comments within the following table:

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| Companies | Comments |
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# 5 [Active] MISC

The WID objective is copied below for reminder

Study and specify needed improved GNSS operations for a new position fix for UE pre-compensation during long connection times and for reduced power consumption. Simultaneous GNSS and NTN NB-IoT/eMTC operation is not assumed. [RAN1, RAN2]

Based on the moderator understanding of the Rel-18 IoT NTN WID objectives and conclusions / agreements in Rel-17 IoT NTN Work Item, the following proposals are made for sub-sections 5.1, 5.2, 5.3.

## 5.1 GNSS assistance information

The moderator recalls the agreements for GNSS assistance information.

**Agreement (RAN1 107-e):**

The UE autonomously determines its GNSS validity duration X and reports information associated with this valid duration to the network via RRC signalling.

* X = {10s, 20s, 30s, 40s, 50s, 60s, 5 min, 10 min, 15 min, 20 min, 25 min, 30 min, 60 min, 90 min, 120 min, infinity}

Send LS to RAN2 to take the following RAN1 agreements into consideration to specify the aspects related to GNSS position validity:

* For sporadic short transmission, UE in RRC\_CONNECTED should go back to idle mode and re-acquire a GNSS position fix if GNSS becomes outdated
* The UE autonomously determines its GNSS validity duration X and reports information associated with this valid duration to the network via RRC signalling.
	+ X = {10s, 20s, 30s, 40s, 50s, 60s, 5 min, 10 min, 15 min, 20 min, 25 min, 30 min, 60 min, 90 min, 120 min, infinity}
* Note: The duration of the short transmission is not longer than the “validity timer for UL synchronization” referred to in the WID objective (but which still needs further discussion for specifying further details)

**Agreement (RAN1 109-e):**

UE reports additional GNSS assistance information and further study the detailed GNSS assistance information, including e.g. GNSS position fix measurement time

* Note: Since RAN1 agreed that GNSS validity duration is reported by UE in Rel-17, it is already included in GNSS assistance information.

**Agreement (RAN1 110):**

GNSS assistance information that UE reports to eNB at least consists of:

* GNSS position fix time duration for measurement
* GNSS validity duration

**Agreement (RAN1 110bis-e):**

UE reports GNSS position fix time duration for measurement at least during the initial access stage

* which message carries this information is up to RAN2

**Agreement (RAN1 110bis-e):**

In connected mode, UE may report GNSS validation duration with MAC CE.

**Agreement (RAN1 112):**

UE reports only one GNSS position fix time duration for GNSS measurement at least when moving to RRC connected state.

**Agreement (RAN1 112bis):**

UE reports one GNSS position fix time duration for GNSS measurement via a N-bit field at least including [1,2] seconds as component values.

* FFS: value of N, other component value(s) of GNSS position fix time duration (e.g. N=3, with value in [3,7,13,19,25, X] seconds, and X is FFS).

FFS: whether RAN4 input is needed.

**Agreement (RAN1 113):**

UE reports one GNSS position fix time duration for GNSS measurement via a 4-bit field with component values [1,2,3,4,5,6,7,13,19,25,31]

* FFS: other component values

**Agreement (RAN1 114):**

From RAN1 perspective, during connected mode, reporting of GNSS position fix time duration is not needed except via RRCConnectionReestablishmentComplete, RRCConnectionReestablishmentComplete-NB and RRCConnectionReconfigurationComplete for HO case.

**RAN2-116bis**

UE need to have a valid GNSS fix before going to connected. RAN2 assumes that the UE may need to re-acquire the GNSS fix right before establishing the connection (regardless if previously valid or not), if needed to avoid interruption during the connection.

**RAN2-118**

* A new parameter for remaining GNSS validity duration is introduced in Msg5, e*.g. RRCConnectionResumeComplete*, *RRCConnectionSetupComplete* and RRCreestablishmentComplete messages, and the parameter refers to the time of message transmission.
* P1: The value range of the remaining GNSS validity duration should include the values proposed by RAN1 , i.e. {10s, 20s, 30s, 40s, 50s, 60s, 5 min, 10 min, 15 min, 20 min, 25 min, 30 min, 60 min, 90 min, 120 min, infinity}.
* P3: The new parameter for remaining GNSS validity duration is introduced in the following Msg5 messages: RRCConnectionResumeComplete, RRCConnectionSetupComplete, RRCreestablishmentComplete RRCConnectionResumeComplete-NB, RRCConnectionSetupComplete-NB, RRCreestablishmentComplete-NB.
* P4: The new parameter for remaining GNSS validity duration is introduced in *RRCConnectionReconfigurationComplete* for MTC Handover.
* P5: No new RRC release cause “GNSS invalidity” is introduced in RRC Release.
* This mechanism is not configurable, and the UE always reports.

**RAN2-121**

* For UE to report GNSS position fix time duration for measurement during the initial access, at least the following Msg5 message can be used:

 o RRCConnectionSetupComplete, RRCConnectionSetupComplete-NB,

 o RRCConnectionResumeComplete, RRCConnectionResumeComplete-NB,

 o FFS for RRCreestablishmentComplete and RRCConnectionReconfigurationComplete.

 o FFS for Msg3

* FFS whether the UE can stay in RRC\_CONNECTED state when current GNSS position becoming out-of-date if the UE has initiated a new measurement
* The value range {10s, 20s, 30s, 40s, 50s, 60s, 5 min, 10 min, 15 min, 20 min, 25 min, 30 min, 60 min, 90 min, 120 min, infinity} introduced in R17 is reused for connected UE GNSS validation duration report, unless modified by RAN1.
* UE reports GNSS validity duration after GNSS measurement. FFS whether the UE reports every time or only if the validity duration changes. FFS if the duration is the remaining validity duration or the whole duration

**RAN2-121bis**

There is no need for UE to provide GNSS position fix time duration in Msg3.

Working Assumption:

1. GNSS validity duration UE reported after GNSS measurement is the remaining validity duration

**RAN2-122**Confirm the working assumption that GNSS validity duration UE reports is the remaining validity duration.

GNSS fix time duration should be reported in 1) and 2):

* + RRCConnectionReestablishmentComplete and RRCConnectionReestablishmentComplete-NB
	+ RRCConnectionReconfigurationComplete for HO case
	+ (FFS whether there are some scenarios where this is not needed or whether there has to be some explicit NW indication to do so)

#### 5.1.1 Company contributing views

|  |  |
| --- | --- |
| Contribution | Observation/Proposals |
| Ericsson | Observation 3: A UE may complete GNSS reacquisition at any point in time within the aperiodic/autonomous GNSS gap which will be unknown to the network.Observation 4: When the remaining GNSS validity duration is much larger than the GNSS gap duration, a precise reference point for the start of the GNSS validity duration is not essential.Observation 5: When the remaining GNSS validity duration is on the same order as the GNSS gap duration, a precise reference point for the start of the remaining GNSS validity duration is essential. Otherwise, there will be a significant ambiguity in the remaining GNSS validity duration, e.g., with a GNSS gap of 7 sec and the remaining GNSS validity duration of 10 sec, the ambiguity can be up to 7 sec as the network does not know if the UE used the start or the end of the GNSS gap as the reference point.Observation 6: UE and eNB need to have a common understanding about the reference point for the reported GNSS validity duration.Proposal 2: The reference point for the reported GNSS validity duration will be the start of the GNSS measurement gap or the start of the autonomous GNSS timer in which the GNSS position fix is acquired. |

Ericsson mentioned a UE may complete GNSS reacquisition at any point in time within the aperiodic/autonomous GNSS gap which will be unknown to the network. When the remaining GNSS validity duration is much larger than the GNSS gap duration, a precise reference point for the start of the GNSS validity duration is not essential. When the remaining GNSS validity duration is on the same order as the GNSS gap duration, a precise reference point for the start of the remaining GNSS validity duration is essential. Otherwise, there will be a significant ambiguity in the remaining GNSS validity duration, e.g., with a GNSS gap of 7 sec and the remaining GNSS validity duration of 10 sec, the ambiguity can be up to 7 sec as the network does not know if the UE used the start or the end of the GNSS gap as the reference point. UE and eNB need to have a common understanding about the reference point for the reported GNSS validity duration. Ericsson further proposed the reference point for the reported GNSS validity duration will be the start of the GNSS measurement gap or the start of the autonomous GNSS timer in which the GNSS position fix is acquired.

Moderator View: For the reference point of remaining GNSS validity duration, RAN2 123 has agreed that MAC layer should guarantee the reported remaining GNSS measurement validity duration is the **latest** value. To the moderator understanding, the latest value is the one when MAC layer generates remaining GNSS measurement validity duration MAC CE. Given that it is the maintenance meeting in R18 that RAN1 should deal with the more critical issues in priority, the following FL recommendation is made.

#### 5.1.2 First Round Discussion

***FL recommendation 5.1:***

***Proponents for following enhancements on reference point of remaining GNSS validity duration is encouraged to further discuss offline on whether further enhancement is needed for reference point of remaining GNSS validity duration in NTN-IoT R18.***

Companies are encouraged to provide comments within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
|  |  |
|  |  |
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|  |  |

## 5.2 PDCCH order/DCI-based GNSS measurement trigger

#### 5.2.1 Company contributing views

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| --- | --- |
| Contribution | Observation/Proposals |
| Samsung | Proposal 3: Besides MAC CE based triggering signaling, PDCCH order/DCI based triggering signaling can be considered. |

Samsung observed that considering aperiodic GNSS measurement may be triggered under the case UL synchronization is lost. In this case, the UE cannot send HARQ-ACK for MAC CE triggering signaling. Thus, eNB cannot sure whether the MAC CE is successfully received by the UE. Therefore, DCI based triggering signaling should be supported for this case. In addition, after GNSS measurement is completed and new GNSS position fix is obtained, PRACH can be transmitted for the purpose of UL resynchronization. So, the DCI used for indication of PDCCH order RACH can also be used to trigger a new GNSS measurement, e.g., implicit indication without any change for all of the DCI fields, or using some reserved bit(s) in the DCI. And, the PDCCH order RACH can be initiated after completing GNSS measurement by the UE.

Moderator View: On PDCCH order/DCI-based trigger, GNSS position fix trigger will be a rather infrequent case, the agreed MAC CE is enough and DCI-based solution may involve spec impact (e.g. implicit indication field or condition or which field can be reused in the DCI or dedicated resource for RACH). Given that it is the maintenance meeting in R18 that RAN1 should deal with the more critical issues in priority, the following FL recommendation is made.

#### 5.2.2 First Round Discussion

***FL recommendation 5.2:***

***Proponents for PDCCH order/DCI-based GNSS measurement trigger are encouraged to further discuss offline on whether further enhancement is needed for PDCCH order/DCI-based GNSS measurement trigger in NTN-IoT R18.***

Companies are encouraged to provide comments on the FL recommendation within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
|  |  |
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## 5.3 Skip GNSS measurement trigger

**Agreement (RAN1 110)**

When eNB triggers UE to make GNSS measurements, UE re-acquires GNSS position fix

* FFS details of signalling
* FFS how UE reports GNSS assistance information after eNB trigger and the detailed content
* Note: further discuss whether a UE is expected to handle all eNB triggers

#### 5.3.1 Company contributing views

|  |  |
| --- | --- |
| Contribution | Observation/Proposals |
| Qualcomm | Proposal 2: If the UE receives a GNSS aperiodic trigger when the remaining GNSS validity duration is larger than Z, the UE is allowed to skip the GNSS reacquisition.•The UE reports the remaining validity duration after skipping the GNSS reacquisition. |

Qualcomm mentioned if the GNSS trigger is received long before the expiration of the validity timer (e.g. in case a previous validity duration report was lost), the UE should be allowed to skip the GNSS reacquisition and report the current validity duration. Qualcomm further proposed if the UE receives a GNSS aperiodic trigger when the remaining GNSS validity duration is larger than Z, the UE is allowed to skip the GNSS reacquisition and the UE reports the remaining validity duration after skipping the GNSS reacquisition.

Moderator View: RAN1 has agreed that for eNB aperiodically triggers UE to make GNSS measurement, a MAC CE is used. To the moderator understanding, the aperiodically triggered GNSS measurement gap should only be triggered by eNB when there does have a need for UE to do GNSS measurement. Given that it is the maintenance meeting in R18 that RAN1 should deal with the more critical issues in priority, the following FL recommendation is made.

#### 5.3.2 First Round Discussion

***FL recommendation 5.3:***

***Proponents for skipping the GNSS reacquisition aperiodically triggered by network are encouraged to further discuss offline on whether further enhancement is needed for skipping the GNSS reacquisition aperiodically triggered by network in NTN-IoT R18.***

Companies are encouraged to provide comments on the FL recommendation within the following table:

|  |  |
| --- | --- |
| Companies | Comments |
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# 6 Proposals for online/offline discussions

## 6.1 Proposals for Tuesday offline discussion

Issue #2: GNSS measurement gap/timer

***Initial Proposal 2-1:***

***Modify X1 value of RAN1#114 agreement on start time of GNSS measurement gap as follows:***

***For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled***

* ***X1=12ms for NB-IoT***
* ***X1=5~~6~~ms for eMTC***

Issue #4: TPs

***Initial Proposal 4.1a:***

***TP#1 in section 4.1.2 of R1-2312298 is endorsed for TS36.213 Clause 16.10.***

Issue #1: UL transmission after original validity duration expires and potential enhancements

**Initial Proposal 1-1a:**

**From RAN1 perspective, *the start time of duration X is at the point where original GNSS validity duration expires.***

**Initial Proposal 1-1b:**

**From RAN1 perspective, *the start time of duration X ~~should be~~ is at the point where original GNSS validity duration expires***

* ***when timeAlignmentTimer is not infinity, down select:***
	+ ***Alt-1:*** ***the end of X ~~should be~~ is at the point where timeAlignmentTimer expires and the timeAlignmentTimer is reset every time when MAC CE TAC is received***
	+ ***Alt-2:*** ***the end of X ~~should be~~ is at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to timeAlignmentTimer every time when MAC CE TAC is received***
* ***when timeAlignmentTimer is infinity, down select:***
	+ ***Alt-3: X is equal to a single configured value Y without extension when MAC CE TAC is received***
	+ ***Alt-4: the end of X ~~should be~~ is at the point where new timer ULTransimissionExtentionTimer expires and ULTransimissionExtentionTimer is reset with length equal to Y every time when MAC CE TAC is received***

Alt 1:

Alt 2:

Alt 3:

Alt 4:

Issue #1: UL transmission after original validity duration expires and potential enhancements

**Initial Conclusion 1-2:**

**From RAN1 perspective, *the latest GNSS position fix obtained before duration X is triggered, can be utilized for calculating for uplink transmission within duration X.***

***Note:*** ***no change to existing RAN1 spec***

Support:

Not support:

Issue #2: GNSS measurement gap/timer

***Initial Proposal 2-2:***

***If UE supports both aperiodic GNSS measurement gap and autonomous GNSS measurement timer, eNB trigger with MAC CE to make GNSS measurement in GNSS measurement gap does not impact the autonomous GNSS reacquisition after the GNSS measurement gap.***

***Initial Proposal 2-2a:***

***The UE may re-acquire GNSS autonomously (when configured by the network) in the GNSS measurement timer, if UE does not receive eNB trigger to make GNSS measurement within duration T, where T is latest reported remaining GNSS validity duration plus UL transmission extension duration X (if any).***

Support:

Not support:

Issue #4: TPs

***Initial Proposal 4.4:***

***Companies are encouraged to comment on whether TPs in section 4.4.2 of R1-231XXXX are needed.***

Support PRACH enhancements in duration X:

Not support PRACH enhancements in duration X:

Issue #4: TPs

***Initial Proposal 4.2:***

***TP#2 in section 4.2.2 of R1-231XXXX is endorsed for TS36.213 Clause 16.10 and Clause 18.***

## 6.1 Proposals for Tuesday online discussion

Issue #2: GNSS measurement gap/timer

***Initial Proposal 2-1:***

***Modify X1 value of RAN1#114 agreement on start time of GNSS measurement gap as follows:***

***For the aperiodic GNSS measurement gap triggered by eNB with MAC CE, the start time of the gap should be at n+ X1, where n is the end of MAC CE receiving subframe/slot when HARQ feedback for the MAC CE is disabled***

* ***X1=12ms for NB-IoT***
* ***X1=5~~6~~ms for eMTC***

Issue #4: TPs

***Initial Proposal 4.1a:***

***TP#1 in section 4.1.2 of R1-2312298 is endorsed for TS36.213 Clause 16.10.***

# 7 Conclusion

# 8 References

1. RP-223519, Moderator (MediaTek), Revised WID on IoT NTN enhancements, 12-16 December, 2022
2. R1-2310879, Maintenance of improved GNSS operations for IoT NTN, Huawei, HiSilicon
3. R1-2311181, Remaining issues on improved GNSS operations for IoT NTN, Spreadtrum Communications
4. R1-2311203, Remaining issue on improved GNSS operation, ZTE
5. R1-2311248, Discussion on remaining issue for improved GNSS operation for IoT NTN, OPPO
6. R1-2311512, Remaining issues on Improved GNSS operations for IoT NTN, NEC
7. R1-2311586, Discussion on the remaining issues for the improved GNSS operation for IoT NTN, Beijing Xiaomi Mobile Software
8. R1-2311655, Maintenance on improved GNSS operations for IoT NT, Nokia, Nokia Shanghai Bell
9. R1-2311703, Remaining issues on improved GNSS operations for IoT NTN, Apple
10. R1-2311863, Remaining issues for improved GNSS operations for IoT NTN, Samsung
11. R1-2311943, On maintenance of improved GNSS operations for IoT NTN, Ericsson Inc.
12. R1-2311999, Remaining issues on improved GNSS operations for IoT NTN, MediaTek Inc.
13. R1-2312054, Improved GNSS Operations for IoT-NTN, Qualcomm Incorporated
14. R1-2312128, Improved GNSS operation for IoT NTN, Nordic Semiconductor ASA

# 9 Appendix

## 9.1 TP1 of R1-2310879 from Huawei, HiSilicon

**Reason for Change:**

In the endorsed editor CR [6] after RAN1#114bis, the starting point of a measurement gap is counted from the starting point of last subframe carrying triggering MAC CE, which is one subframe early than the agreement in RAN1#114. To keep the same time budget for processing the triggering MAC CE, the starting point of measurement gap should be in subframe n+13 for NB-IoT.

**Summary of change:**

Change the start of the measurement gap in subframe n+13 if UE shall not provide HARQ-ACK information for the NPDSCH carrying the triggering MAC CE

**Proposed TP1** for clause 16.10 in TS36.213 based on the endorsed CR [6]

|  |
| --- |
| 16.10 GNSS measurement gap related proceduresFor a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe *n*,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe *n*+13- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH. |

## 9.2 TP2 of R1-2310879 from Huawei, HiSilicon

**Reason for change:**

In the TS 36.213 v18.0.0, the procedure of improved GNSS operations for IoT NTN was captured based on the last meeting. More specifically, the start and end time of GNSS measurement gap triggered by MAC CE was captured. However the RAN1 agreements illustrated below also impact the physical layer procedures and is not captured in both RAN1 (TS36.213 v18.0.0) and RAN2 (TS 36.331 v17.6.0, TS 36.321 v17.6.0) running CR as following：

|  |
| --- |
| **Agreement**The UE is not required to transmit or receive any channel / signal within the aperiodic GNSS measurement gap duration before the UE reacquires GNSS successfully. FFS: UE’s behavior within the duration after UE reacquires GNSS successfully to the end of the gap if the UE reacquires GNSS successfully before the end of the gap.AgreementThe UE is not required to monitor N/MPDCCH within the aperiodic GNSS measurement gap, except after a CBRA (PRACH) is sent.* CBRA (PRACH) can be sent at least to request UL resource to report the remaining GNSS validity duration.

Note1: The CBRA (PRACH) can only be sent within the duration after UE reacquires GNSS successfully to the end of the gap.Note2: Whether CBRA (PRACH) is sent is up to UE implementation.Note3: no change to existing CBRA proceduresFFS: whether other RA procedure is needed. |

**Summary of change:**

The procedure of transmission/reception of physical layer channels/signals during the GNSS measurement gap for IoT NTN in TS36.213.

**Consequence if not approved:**

The RAN1 agreements for GNSS measurement are not captured in specification.

Proposed TP2 for clause 16.10 for NB IoT and clause 18 for eMTC in TS36.213 based on the endorsed CR [6] is as following:

|  |
| --- |
| < Unchanged parts are omitted >**16.10 GNSS measurement gap related procedures**For a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe n+12- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.During the GNSS measurement gap, a NB-IoT UE in a NTN FDD serving cell is not expected to transmit or receive any physical channels/signals before the UE reacquires GNSS. UE may initiate contention based random access procedure and start to monitor NPDCCH after UE reacquires GNSS during the GNSS measurement gap.Every time after successful GNSS measurement, UE should report the remaining GNSS validity duration through in GNSS Validity Duration Report MAC CE defined in clause 5.4.xx in TS36.321 [8].<Unchanged parts are omitted>**18 GNSS measurement gap related procedures for BL/CE UE**For a BL/CE UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a PDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the PDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe n+7- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the HARQ-ACK transmission for the HARQ process associated with the transport block in the PDSCH.During the GNSS measurement gap, a BL/CE UE in a NTN FDD serving cell is not expected to transmit or receive any physical channels/signals before the UE reacquires GNSS. UE may initiate contention based random access procedure and start to monitor MPDCCH after UE reacquires GNSS during the GNSS measurement gap.Every time after successful GNSS measurement, UE should report the remaining GNSS validity duration through in GNSS Validity Duration Report MAC CE defined in clause 5.4.xx in TS36.321 [8]. <Unchanged parts are omitted> |

## 9.3 TP of R1-2311181 from Spreadtrum

|  |  |
| --- | --- |
| Reason for change | Measurement gap for RRM and GNSS measurement gap need to be distinguished in the specification.  |
| Summary of change | Section 16.10 in 36.213: Change measurement gap to GNSS measurement gap in 16.10 in 36.213. |
| Consequences if not approved | Measurement gap for RRM and GNSS measurement gap can not be distinguished in the specification. |
| Text proposal | TS 36.21316.10 GNSS measurement gap related procedures\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged parts omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\*For a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe *n*,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the GNSS measurement gap in subframe *n*+12- otherwise,- the UE shall assume the start of the GNSS measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged parts omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

## 9.4 TP1 of R1-2311999 from MediaTek

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| --- |
| ========================= Start of TP #1 for TS 36.213 =========================16.6 Narrowband physical downlink control channel related proceduresThroughout this clause, if a NB-IoT UE is configured with higher layer parameter *k-Mac*, *K*mac = *k-Mac* otherwise, *K*mac = 0.A UE shall monitor a set of NPDCCH candidates (described in Clause 10.2.5.1 of [3]) as configured by higher layer signalling for control information, where monitoring implies attempting to decode each of the NPDCCHs in the set according to all the monitored DCI formats.The set of NPDCCH candidates to monitor are defined in terms of NPDCCH search spaces.<Unchanged parts are omitted>An NB-IoT UE is not required to monitor NPDCCH candidates of an NPDCCH search space during an NPUSCH UL gap.An NB-IoT UE is not required to monitor NPDCCH candidates of a Type2A-NPDCCH common search space during the scheduling gap or the processing gap.An NB-IoT UE is not required to monitor NPDCCH within the aperiodic GNSS measurement gap, except after a contention based Random Access is performed as specified in TS 36.321 [8].<Unchanged parts are omitted>============================= End of TP #1 for TS 36.213 ============================= |

## 9.5 TP2 of R1-2311999 from MediaTek

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| --- |
| ========================= Start of TP #2 for TS 36.213 =========================16.10 GNSS measurement gap related proceduresFor a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe *n*,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe *n*+13- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.<Unchanged parts are omitted>============================= End of TP #2 for TS 36.213 ============================= |

## 9.6 TP1 of R1-2312054 from Qualcomm

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| --- |
| **============================= <TP1 36.213, Clause 16.10> =============================**16.10 GNSS measurement gap related proceduresFor a NB-IoT UE in a NTN FDD serving cell, when the UE receives a GNSS Measurement Command MAC CE in a NPDSCH ending in DL subframe n,- if the UE shall not provide HARQ-ACK information for the HARQ process associated with the transport block in the NPDSCH carrying GNSS Measurement Command MAC CE,- the UE shall assume the start of the measurement gap in subframe *n*+13- otherwise,- the UE shall assume the start of the measurement gap in subframe *k*+2, where *k* is the first DL subframe after the end of the transmission of the NPUSCH carrying ACK/NACK response for the HARQ process associated with the transport block in the NPDSCH.**================================= </TP1> =====================================** |

## 9.7 TP2 of R1-2312054 from Qualcomm

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| **============================== <TP2.1 36.211> ==================================**5.7.1 Time and frequency structure**<Unchanged parts are omitted>**The start of the random access preamble formats 0-3 shall be aligned with the start of the corresponding uplink subframe at the UE assuming  except if *GNSSExtensionByClosedLoop* is configured, in which case the accumulated is used. The random access preamble format 4 shall start  before the end of the UpPTS at the UE, where the UpPTS is referenced to the UE's uplink frame timing assuming.**<Unchanged parts are omitted>****================================= </TP2.1> ======================================****============================== <TP2.2 36.213> ==================================**4.2.3 Transmission timing adjustmentsUpon reception of a timing advance command or a timing adjustment indication for a TAG containing the primary cell or PSCell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS, and PRACH if higher layer parameter *GNSSExtensionByClosedLoop,* of the primary cell or PSCell based on the received timing advance command or a timing adjustment indication.**<Unchanged parts are omitted>**In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is not configured*,* an 11-bit timing advance command [8], *TA*, for a TAG indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 256 if the UE is configured with a SCG, and *TA* = 0, 1, 2, ..., 1282 otherwise, where an amount of the time alignment for the TAG is given by *NTA* = *TA* ×16. *NTA* is defined in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is configured*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ×16. In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format 6-0A/B if present [4], *TA*, for a TAG indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a given amount respectively.**<Unchanged parts are omitted>**16.1.2 Timing synchronizationUpon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH, and SR if configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, and NPRACH if configured with higher layer parameter *GNSSExtensionByClosedLoop,* based on the received timing advance command.The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16. The start timing of the random access preamble is specified in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is not configured*,* an 11-bit timing advance command [8], *TA*, indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA* = *TA* ×16. *NTA* is defined in [3].In case of random access response, and if higher layer parameter *GNSSExtensionByClosedLoop* is configured*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ×16. In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format N0 if present [4], *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.**================================= </TP2.2> ======================================** |