**3GPP TSG RAN WG1 Meeting #106-bis-e R1-210xxxx**

**e-Meeting, October 11th – 19th, 2021**

**Agenda Item: 8.15**

**Source: Moderator (MediaTek)**

**Title: Summary of [106bis-e-R17-RRC-IoT-NTN] Email discussion on Rel-17 RRC parameters for NB-IoT/eMTC support for NTN**

**Document for: Discussion**

# Introduction

There was a preliminary email discussion on RRC parameters for NB-IoT/eMTC to support NTN [4]. RRC parameters pertinent for IoT NTN will be further discussed in RAN1#106bis-e.

This document is the Summary of [106bis-e-R17-RRC-IoT-NTN] Email discussion on Rel-17 RRC parameters for IoT over NTN

* 1st check point: October 14
* Final check point: October 19

# Time and frequency synchronization

## Related RRC parameters

Based on the agreements to date (up to RAN1#106-e) and the companies proposals submitted to RAN1#106-bis-e, a preliminary list of RRC parameters for Rel-17 IoT NTN and related to 8.15.1 Enhancements to time and frequency synchronization is provided below:

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| **WI code** | **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| LTE\_NBIOT\_eMTC\_NTN | Uplink Time pre-compensation | 36.213 |  |  |  | ULTimePre-compensation-r17NTACommon-r17SatelliteEphemerisStateVector-r17SatelliteOrbitalParameters-r17 | new |  | 1. UE specific TA calculation in RRC\_IDLE state based on its GNSS-acquired position and the serving satellite ephemeris.
2. UE specific TA calculation in RRC\_CONNECTED state based on its GNSS-acquired position and the serving satellite ephemeris.
3. UE applies common TA in RRC\_IDLE and RRC\_CONNECTED according to the parameters provided by the network (if any)
4. 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

N\_(TA,common) is a network-controlled common TA, and may include any timing offset considered necessary by the network.When configured, N\_(TACommon) provides network-controlled common TA. It includes parameter X, Y, .N\_TAcommon with value of 0 is supported. Serving Satellite position state vector X,Y,Z in ECEF (m) and serving Satellite velocity state vector VX,VY,VZ in ECEF (m/s) is indicated Serving satellite Ephemeris orbital parameters are indicated:- Semi-major axis α [m] - Eccentricity e - Argument of periapsis ω [rad] - Longitude of ascending node Ω [rad] - Inclination i [rad] - Mean anomaly M [rad] at epoch time toServing satellite ephemeris Epoch time is implicitly known | TBD |  | cell | Cell-specific | 36.331 | TBD Value range based on NR NTN progress |
| LTE\_NBIOT\_eMTC\_NTN | Uplink Frequency pre-compensation | 36.213 |  |  |  | ULFrequencyPre-compensation-r17SatelliteEphemerisStateVector-r17SatelliteOrbitalParameters-r17 |  |  | 1. In RRC\_IDLE state calculate frequency pre-compensation to counter shift the Doppler experienced on the service link.
2. in RRC\_CONNECTED state, calculate frequency pre-compensation to counter shift the Doppler experienced on the service link.

Serving Satellite position state vector X,Y,Z in ECEF (m) and serving Satellite velocity state vector VX,VY,VZ in ECEF (m/s) is indicated Serving Satellite Ephemeris orbital parameters are indicated:- Semi-major axis α [m] - Eccentricity e - Argument of periapsis ω [rad] - Longitude of ascending node Ω [rad] - Inclination i [rad] - Mean anomaly M [rad] at epoch time to |  |  |  |  |  |  |
| LTE\_NBIOT\_eMTC\_NTN | UL-Synchronization -Validity-IoT NTN | 36.213 |   |   |   | ULSyncValidityDuration-r17 | new | Validity timer for UL synchronization for NB-IoT or eMTC | • Satellite ephemeris read on SIB are valid for the duration of sporadic short transmission in RRC\_CONNECTED.• Common TA parameters if indicated and read on SIB are valid for the duration of sporadic short transmission in RRC\_CONNECTED.• 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)The validity timer of UL synchronization is configured by the network. FFS: Whether a single validity timer or separate validity timers are used for satellite ephemeris and common TA parametersUE in RRC\_IDLE reads the satellite ephemeris on SIB and the common TA parameters if indicated on SIB and (re-)start the validity timer(s) for UL synchronization before moving to RRC\_CONNECTED.FFS: Details of the precise (re-)start time for the validity timer for UL synchronization to ensure a common understanding between gNB and UE. Other signaling details for validity timer are up to RAN2”A validity duration configured by the network for satellite ephemeris data / Common TA parameters if broadcast which indicates the maximum time during which the UE can apply the satellite ephemeris / common TA parameres if broadcast without having acquired new satellite ephemeris / common TA parameters if broadcast. | TBD |   | Cell | Cell-specifc | 36.331 | FFS: Whether a single validity timer or separate validity timers are used for satellite ephemeris and common TA parameters |
| LTE\_NBIOT\_eMTC\_NTN | UL synchronization-Transmission-IoT NTN | 36.213 |   |   |   | TransmissionDurationNPRACH-NB-r17 | new | Duration of UL transmission segment for UE pre-compensation for NPRACH transmission for NB-IoT | The UL transmission segment length for NPRACH refers to the duration of time during which the applied pre-compensation shall not be changed by the UE.The UL transmission segment duration is provided by UE-specific RRC signalling or by signalling in SIB.Duration of UL transmission segment for UE pre-compensation for NPRACH transmission is a number of NRACH repetition units configured by the network for NB-IoT NTN | For NB-IoT NTN, the network configures one of K values for the UL transmission segment duration of each PRACH preamble format in a k-bit field, where the size of the k-bit field and the number of K candidate values depend on the preamble format.- Format 0 and format 1: 3-bit field, K=6 candidate values [2.4.(TCP+TSEQ), 4.4.(TCP+TSEQ), 8.4.(TCP+TSEQ), 16.4.(TCP+TSEQ), 32.4.(TCP+TSEQ), 64.4.(TCP+TSEQ)- Format 2: 2-bit field, K=4 candidate values 2.6.(TCP+TSEQ), 4.6.(TCP+TSEQ), 8.6.(TCP+TSEQ), 16.6.(TCP+TSEQ) ]FFS: Down scoping of K candidate values, size of k-bit fieldFFS: Whether the same segment duration can be used for all preambles within a preamble format |   | TBD | TBD | 36.331 | NOTE: the values of UL transmission segment duration for NB-IoT can be different to those for eMTCFFS: Down scoping of K candidate values, size of k-bit fieldFFS: Whether the same segment duration can be used for all preambles within a preamble format |
| LTE\_NBIOT\_eMTC\_NTN | UL synchronization-Transmission-IoT NTN | 36.213 |   |   |   | TransmissionDurationPRACH-r17 | new | Duration of UL transmission segment for UE pre-compensation for PRACH transmission for eMTC | The UL transmission segment length for PRACH refers to the duration of time during which the applied pre-compensation shall not be changed by the UEThe UL transmission segment duration is provided by UE-specific RRC signalling or by signalling in SIB. | For eMTC, the network configures one of K values for the UL transmission segment duration of PRACH in a k-bit fieldFFS: K candidate values, size of k-bit field |   | TBD | TBD | 36.331 | NOTE: the values of UL transmission segment duration for NB-IoT can be different to those for eMTCFFS: K candidate values, size of k-bit field |
| LTE\_NBIOT\_eMTC\_NTN | UL synchronization-Transmission-IoT NTN | 36.213 |   |   |   | TransmissionDurationNPUSCH-NB-r17 | new | Duration of UL transmission segment for UE pre-compensation for NPUSCH transmission for NB-IoT | The UL transmission segment length for NPUSCH refers to the duration of time during which the applied pre-compensation shall not be changed by the UE.Duration of UL transmission segment for UE pre-compensation for NPUSCH transmission is a number of PUSCH repetition units configured by the networkFor NB-IoT, repetition unit is M\_identical^NPUSCH×N\_slot^UL×T\_slot  | For NB-IoT/eMTC NTN, the network configures one of K candidate values for the UL transmission segment duration of NPUSCH/PUSCH in a k-bit field. For NB-IoT, maximum 3-bit field with a maximum number of K=8 candidate values [2 ms, 4 ms, 8 ms, 16 ms, 32 ms, 64 ms, 128 ms, 256 ms] FFS: Down scoping of K candidate values, size of k-bit field |   | TBD | TBD | 36.331 | FFS: RAN1 to further discuss valid and invalid subframes FFS: Configuration detailsFFS: Down scoping of K candidate values, size of k-bit field |
| LTE\_NBIOT\_eMTC\_NTN | UL synchronization-Transmission-IoT NTN | 36.213 |   |   |   | TransmissionDurationPUSCH-r17 | new | Duration of UL transmission segment for UE pre-compensation for PUSCH transmission for eMTC | The UL transmission segment length for PUSCH refers to the duration of time during which the applied pre-compensation shall not be changed by the UE.Duration of UL transmission segment for UE pre-compensation for PUSCH transmission is a number of PUSCH repetition units configured by the network For eMTC, repetition unit is N\_slot^UL×T\_slot for sub-PRB allocation, where Tslot = 0.5 ms. For full-PRB allocation, repetition unit is one subframe. | For NB-IoT/eMTC NTN, the network configures one of K candidate values for the UL transmission segment duration of NPUSCH/PUSCH in a k-bit field. FFS: Down scoping of K candidate values, size of k-bit field |   | TBD | TBD | 36.331 | FFS: RAN1 to further discuss valid and invalid subframes FFS: Configuration detailsFFS: Down scoping of K candidate values, size of k-bit fieldNOTE: although it is not yet agreed by RAN1, it is expected that a corresponding (or the same) parameter will be needed also for PUCCH. |

## Company views

Apple R1-2110073, Ericsson R1-2109959, Samsung R1-2109536 proposed to remove rows 2-1 (NTAcommon), 2-2 (serving satellite ephemeris position and velocity state vector) and 2-3 (serving satellite orbital parameters) in R1-2108672 List of Rel-17 RRC parameters for IoT NTN submitted to RAN1#106-e.

* These rows were removed and merged into two new rows for “Uplink Time pre-compensation” and “Uplink Frequency pre-compensation”.

Samsung R1-2109536 proposed to add square brackets to parameters/descriptions not yet agreed

* Rows for UL transmission segments with values not yet finalized were put in brackets.

Apple R1-2110073 proposed to merge rows 2-5, 2-6 on validity timer in in R1-2108672 List of Rel-17 RRC parameters for IoT NTN submitted to RAN1#106-e into rows for UE pre-compensation.

* These rows were merged into the with two new rows for “Uplink Time pre-compensation” and “Uplink Frequency pre-compensation”.

ZTE R1-2109851 proposed to add “Serving satellite ephemeris Epoch time is implicitly known”.

* This was added in the two new rows for “Uplink Time pre-compensation” and “Uplink Frequency pre-compensation”.

ZTE R1-2109851 also proposed to add “UE report the validity duration of GNSS” and “Common TA estimation is based on indication of common TA drift rate.”.

* Though the moderator understands the motivation, RAN1 agreement will first be needed.

The revisions mentioned above are consistent with Huawei R1-2109156 proposal to put all the components related to the UL time pre-compensation under the same feature for LTE NB-IoT eMTC NTN.

Huawei R1-2109156 proposed to divide “UL transmission segment” into two feature groups, i.e. “UL transmission segment for NB-IoT” and “UL transmission segment for eMTC”.

* This is done as shown in Section 2.2 and in new version of spreadsheet for List of Rel-17 RRC parameters for IoT NTN.

MODERATOR NOTE: We used and revised the R1-2108672 List of Rel-17 RRC parameters for IoT NTN submitted to RAN1#106-e for the revisions and created a new version for RAN1#106bis-e, instead of the list of UE features submitted to RAN1#106-e since the intention is to provide a list of RRC parameters to RAN2.

**Moderator]:**

Companies are encouraged to provide comments on revised RRC parameters list (section 2.1):

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| **Companies** | **Comments**  |
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## Updated list of RRC parameters based on company views (First round of email discussions)

## Updated list of RRC parameters based on company views (Second round of email discussions)

# Enhancements on 8.15.2 Timing relationship enhancements

## Related RRC parameters

Based on the agreements to date (up to RAN1#106-e) and the companies proposals submitted to RAN1#106-bis-e, a preliminary list of RRC parameters for Rel-17 IoT NTN and related to 8.15.2 Timing relationship enhancements is provided below:

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| **WI code** | **Sub-feature group** | **RAN1 specification** | **Section** | **RAN2 Parant IE** | **RAN2 ASN.1 name** | **Parameter name in the spec** | **New or existing?** | **Parameter name in the text** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** | **Specification** | **Comment** |
| LTE\_NBIOT\_eMTC\_NTN | Timing relationships-Koffset-IoT NTN | 36.213 |   |   |   | CellspecificKoffset -r17Koffset -r17 | new | Enhancing timing relationships using a time offset | UE receives cell specific Koffset or UE specific KoffsetConfiguration of K\_offset is cell-specific and Update of K\_offset is UE-specificUE applies Koffset in timing relationship The Koffset has a unit of a number of slots. | TBD |   | Cell | Cell-specific | 36.331 | The K\_offset is a scheduling offset used for the identified timing relationships that need to be modified for IoT NTN. It has a unit of a number of slots.For IoT NTN, support cell-specific Koffset configuration for use during initial access.For IoT NTN, support the use of UE-specific Koffset in CONNECTED mode.The Koffset is used for- For NB-IoT, on receiving UL grant on DCI format N0 in subframe n, NPUSCH Format 1 is transmitted with a delay of Koffset as compared to transmission as per current specification.- For NB-IoT, on receiving a NPDSCH with a RAR message that ends in subframe n, the corresponding Msg3 is transmitted on NPUSCH format 1, with a delay of Koffset as compared to transmission as per current specification.- For NB-IoT, a UE upon detection of a NPDSCH transmission for which it should provide an ACK/NACK feedback, shall transmit the HARQ ACK/NACK with a delay of Koffset as compared to transmission as per current specification.- For NB-IoT, on receiving a timing advance command ending in DL subframe n, the corresponding adjustment of the uplink transmission timing by the received time advance shall be delayed by Koffset as compared to current specification. For IoT NTN, no modifications are needed for the calculation in NR NTN for estimate of UE-eNB RTT.FFS Configuration, Value of cell-specific Koffset |
| LTE\_NBIOT\_eMTC\_NTN | Timing relationships-TAreport-IoT NTN | 36.213 |   |   |   | TBD | new | TBD | Details are TBD | TBD |   | UE | UE-specific | 36.331 | TBD |

## Company views

Apple R1-2110073 proposed to revise rows for Koffset to use name “enhancing timing relationships using a time offset” and the components toUE receives cell specific $K\_{offset}$ or UE specific $K\_{offset}$ and UE applies $K\_{offset}$ in timing relationship enhancements

* The rows with Koffset and cell-specific Koffset were merged into a new row for Koffset with revised name and description.

ZTE R1-2109851 proposed to add “Configuration of K\_offset” and “Update of K\_offset”.

* It was added that “Configuration of K\_offset is cell-specific” and “Update of K\_offset is UE-specific” into the new row for Koffset

MODERATOR NOTE: We used and revised the R1-2108672 List of Rel-17 RRC parameters for IoT NTN submitted to RAN1#106-e for the revisions and created a new version for RAN1#106bis-e, instead of the list of UE features submitted to RAN1#106-e since the intention is to provide a list of RRC parameters to RAN2.

**Moderator]:**

Companies are encouraged to provide comments on revised RRC parameters list (section 3.1):

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| --- | --- |
| **Companies** | **Comments**  |
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## Updated list of RRC parameters based on company views (First round of email discussions)

## Updated list of RRC parameters based on company views (Second round of email discussions)

# Reference

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|  | 1. R1-2108672 List of RRC parameter for Rel-17 IoT-NTN, up to RAN1 #106-e, Moderator (MediaTek)
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