**3GPP TSG RAN Meeting #92-e RP-211nnn**

**Electronic Meeting, June 14 - 18, 2021 was RP-211457**

**Source: MediaTek Inc., Eutelsat S.A.**

**Title: WID on NB-IoT/eMTC support for NTN**

**Document for: Approval**

**Agenda Item: 10.5.1**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

# Title: NB-IoT/eMTC support for Non-Terrestrial Networks

## Acronym: LTE\_NBIOT\_eMTC\_NTN

## Unique identifier: XXXXXX

Potential target Release: Rel-17

## 1 Impacts *{ For Normative work, identify the anticipated impacts. For a Study, identify the scope of the study.}*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Affects:** | UICC apps | ME | AN | CN | Others (specify) |
| **Yes** |  | X | X | X |  |
| **No** |  |  |  |  | X |
| **Don't know** | X |  |  |  |  |

## 2 Classification of the Work Item and linked work items

### 2.1 Primary classification

This work item is a …

|  |  |
| --- | --- |
| X | Feature |
|  | Building Block |
|  | *Work Task* |
|  | Study Item |

### 2.2 Parent Work Item

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| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
| FS\_LTE\_NBIOT\_eMTC\_NTN | RAN1, RAN2 | 860033 | Study on NB-IoT/eMTC support for Non-Terrestrial Networks |

### 2.3 Other related Work Items and dependencies

|  |
| --- |
| Other related Work Items (if any) |
| Unique ID | Title | Nature of relationship |
| 750040 | Study on NR to support non-terrestrial networks | The proposed study will make use of the channel model defined by the FS\_NR\_nonterr\_nw study. |
| 800099 | Study on solutions for NR to support non-terrestrial networks (NTN) | The proposed study will leverage solutions based on the study FS\_NR\_NTN\_solutions that addressed key impact areas |
| 7770002 | Study on using Satellite Access in 5G (FS\_5GSAT) | Feasibility Study led by SA1 and completed in SA#80 |
| 800026  | Study on architecture aspects for using satellite access in 5G (FS\_5GSAT\_ARCH) | Feasibility Study led by SA2. |
| 860046 | Solutions for NR to support non-terrestrial networks (NTN) ( NR\_NTN\_solutions) | Work Item led by RAN2 |

## 3 Justification

IoT operation is critical in remote areas with low/no cellular connectivity for many different industries, including e.g.:

- Transportation (maritime, road, rail, air) & logistics

- Solar, oil & gas harvesting

- Utilities

- Farming

- Environment monitoring

- Mining etc.

The capabilities of NB-IoT and eMTC are a good fit to the above, but will require satellite connectivity to provide coverage beyond terrestrial deployments, where IoT connectivity is required. There is an urgent need for a standardized solution allowing global IoT operation anywhere on Earth, in view of other solutions already available.

It is important that satellite NB-IoT or eMTC be defined in a complementary manner to terrestrial deployments.

Since RAN#86, FS\_LTE\_NBIOT\_eMTC\_NTN studied the support of Internet of Things Non-Terrestrial Networks (IoT NTN). This study intended to reuse the NR NTN study and conclusions in TR 38.821.The results of this work, including conclusions and recommendations for NB-IoT and eMTC, were captured and endorsed in TR 36.763 V1.0.0 in R1-2106379. NR NTN and IoT NTN have different requirements in terms of cost, complexity, power consumption and scenarios.

This Work Item intends to reuse the conclusions and recommendations of FS\_LTE\_NBIOT\_eMTC\_NTN study item, and the NR\_NTN\_solutions Work Item agreements and conclusions.

## 4 Objective

### 4.1 Objective of Core part WI

The objective of this Work Item is to specify support of NB-IoT and eMTC over NTN. Enhancements shall be specified as described hereafter with the following assumptions:

* Standalone deployment for NB-IoT / eMTC for support in Rel-17 timeframe will be prioritized.
* GNSS capability in the UE is taken as a working assumption for both NB-IoT and eMTC devices. With this assumption, UE can estimate and pre-compensate timing and frequency offset with sufficient accuracy for UL transmission. Simultaneous GNSS and NTN NB-IoT/eMTC operation is not assumed.
* NB-IoT/eMTC design for terrestrial networks shall be reused as much as possible.
* Sporadic short transmission as captured in the TR 36.763
* Transparent payload

#### 4.1.1 RAN1

Specify the following time and frequency synchronization enhancements, using NR\_NTN\_solutions WI agreements as baseline, according to Section 8 in TR 36.763:

- UE pre-compensation including ephemeris format (orbital / Position -Velocity)

- Timing advance formula (granularity of the timing advance may be different)

- Combination of Open (i.e. UE autonomous TA estimation, and common TA estimation) and Closed TA (i.e., received TA commands) control loops in RRC\_CONNECTED state

Agreements on the above are up to the decision in NR\_NTN\_Solutions WI and will be used for IoT NTN with minimum changes, if any.

Specify the following time and frequency synchronization enhancements that are not covered by NR\_NTN\_Solutions WI agreements, according to Section 8 in TR 36.763:

- Long PUSCH and PRACH Transmission enhancements: segmented UE pre-compensations, new UL gaps and/or implementation solutions, time units and duration of segments.

- Validity timer for UL synchronization: satellite ephemeris, and potentially other aspects

- DL synchronization enhancements: A single solution will be selected between: new channel raster, (part of) ARFCN-indication-in-MIB.

- GNSS Measurements: Validity of a GNSS position fix and details of acquiring a GNSS position fix, duration of validity, in RRC CONNECTED mode for sporadic short transmission

Specify the following IoT NTN specific timing relationships enhancements according to Section 8 in TR 36.763:

- Timing relationships for NB-IoT / eMTC: as listed in Section 6.6.3 in TR 36.763

- UL scheduling for FDD-HD: Use of UE-specific TA and/or K\_offset to avoid UL-DL collisions in FDD-HD

- Signalling aspects in UE-specific TA maintenance and reporting, techniques to reduce the signalling load and determination of the UE-specific TA.

#### 4.1.2 RAN2

All cellular IoT features specified up to Rel-16 are supported for IoT NTN unless problems are found.

Specify the following enhancements re-using NR\_NTN\_Solutions WI agreements as a baseline, according to Section 8 in TR 36.763:

- User Plane:

- Enhancements to ra-ResponseWindowSize, mac-ContentionResolutionTimer, HARQ RTT timer, UL HARQ RTT timer, and sr-ProhibitTimer.

- Enhancements to RLC t-Reordering timer.

- Others:

- Provisioning of ephemeris

Specify the following IoT NTN specific enhancements not covered by NR\_NTN\_Solutions WI agreements, according to Section 8 in TR 36.763:

- Architecture:

- Support for EPC

- Mobility and Tracking Area:

- Enhancements to tracking area management using the earth-fixed TA concept, considering both hard-switch and soft-switch options, where in the soft-switch option the network may broadcast more than one Tracking Area Code per PLMN.

- Support of legacy (Rel-16) cell selection/reselection mechanisms without major enhancements. Minor adjustments to existing mobility mechanisms, such as a new parameter values, change to timing etc. can be considered to adapt functionality to NTN.

- Support of legacy (Rel-16) Handover and RLF/reestablishment mechanisms without major enhancements. For eMTC, Rel-16 LTE CHO procedure can be considered without major enhancements. Minor adjustments to existing mobility mechanisms, such as a new parameter values, change to timing etc. can be considered to adapt functionality to NTN.

- Others:

- Support of discontinuous coverage without excessive UE power consumption and without excessive failures / recovery actions. The existing power saving mechanisms e.g. DRX, PSM, eDRX, relaxed monitoring, and (G)WUS can be reused without enhancement. Enhancements to these mechanisms can be considered, to support discontinuous coverage.

#### 4.1.3 RAN3

IoT/MTC NTN support for E-UTRAN (i.e. including S1 interface) will be specified re-using NR NTN functionality as a baseline, where needed. Necessary adjustments will be identified. The following functionality will be addressed::

- Support for fixed earth cell and TA (taking Rel-17 NR NTN as baseline where appropriate)

- Support for country-specific CN routing (taking Rel-17 NR NTN as baseline where appropriate)

- Support for satellite NB-IoT, eMTC and access management

- OAM requirements (taking Rel-17 NR NTN as baseline where appropriate).

#### 4.1.4 RAN4

The following objectives are informative and are expected to be worked on after March 2022 in a release independent manner and Rel-18.

Specify RF and RRM core requirements for eNB and UE. The framework/requirements from NB-IoT/eMTC, and from NR NTN should be re-used when applicable.

Specify IoT NTN for usage in the following NR-NTN exemplary band, reusing NR-NTN framework:

- 1980-2010 MHz in UL and 2170-2200 MHz in DL

NOTE: Further frequency bands could be specified in a band-specific work item.

### 4.2 Objective of Performance part WI

The following objectives are informative and are expected to be worked on after March 2022 in a release independent manner and Rel-18.

Specify the following requirements [RAN4]

- Base station demodulation performance requirements

- UE demodulation performance requirements

- Radio Resource Management performance requirements, including RRM/RLM test cases

- Base station conformance testing

## 5 Expected Output and Time scale

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| **New specifications** *{One line per specification. Create/delete lines as needed}* |
| Type  | TS/TR number | Title | For info at TSG#  | For approval at TSG# | Rapporteur |
|  |  |  |  |  |  |

*{Note 1: Only TSs may contain normative provisions. Study Items shall create or impact only TRs.
"Internal TR" is intended for 3GPP internal use only whereas "External TR" may be transposed by OPs.}*

*{Note 2: The first listed Rapporteur is the specification primary Rapporteur. Secondary Rapporteur(s) are possible for particular aspect(s) of the TS/TR. In this case, their responsibility has to be provided as "Remarks".}*

|  |
| --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| TS 36.211 | LTE; Physical channels and modulation | TSG#94 | Core part |
| TS 36.213 | LTE; Physical layer procedures for control | TSG#94 | Core part |
| TS 36.300 | LTE; Overall description; Stage-2:  | TSG#95 | Core part |
| TS 36.304 | LTE; User Equipment (UE) procedures in idle mode and in RRC Inactive state | TSG#95 | Core part |
| TS 36.305 | Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN | TSG#95 | Core part |
| TS 36.306 | LTE; User Equipment (UE) radio access capabilities | TSG#95 | Core part |
| TS 36.321 | LTE; Medium Access Control (MAC) protocol specification:  | TSG#95 | Core part |
| TS 36.322 | LTE; Radio Link Control (RLC) protocol specification | TSG#95 | Core part |
| TS 36.331 | LTE; Radio Resource Control (RRC); Protocol specification | TSG#95 | Core part |
| TS 36.101 | User Equipment (UE) radio transmission and reception | TSG#95 | Core part |
| TS 36.104 | LTE; Base Station (BS) radio transmission and reception | TSG#95 | Core part |
| TS 36.133 | LTE; Requirements for support of radio resource management | TSG#95 | Core part |
| TS 36.101 | User Equipment (UE) radio transmission and reception | TSG#97 | Perf part |
| TS 36.104 | LTE; Base Station (BS) radio transmission and reception | TSG#97 | Perf part |
| TS 36.133 | LTE; Requirements for support of radio resource management | TSG#97 | Perf part |
| TS 36.141-1 | LTE; Base Station (BS) conformance testing part 1 | TSG#97 | Perf part |
| TS 36.141-2 | LTE; Base Station (BS) conformance testing part 2 | TSG#97 | Perf part |

## 6 Work item Rapporteur(s)

Gilles Charbit, MediaTek Inc., gilles dot charbit at mediatek dot com (RAN1)

René Faurie, Eutelsat, rfaurie-ls at sfr dot fr (RAN2)

## 7 Work item leadership

Lead: RAN1

Secondary: RAN2

## 8 Aspects that involve other WGs

*{Specify all the other WG(s) to be involved and, if specific, their task. E.g.: "SA2, SA3, SA5. CT6 for storage, and potentially SA4". If not applicable, indicate "None" or "None identified yet".}*

## 9 Supporting Individual Members

*{At least 4 supporting Individual Members are needed. There is an expectation that these companies will provide resources to progress the work. Note that having 4 supporting companies is a necessary but not sufficient condition: the usual TSG approval process by consensus is needed for the WID approval.}*

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| Supporting IM name |
| MediaTek Inc. |
| Eutelsat S.A. |
| Avanti |
| China Mobile Com. Corporation |
| China Unicom |
| EDF Recherche et Développement |
| ESA |
| FGI |
| Gatehouse Satcom A/S |
| Hughes Network Systems Ltd |
| Inmarsat |
| Kepler |
| KT Corp. |
| KT Sat. |
| Ligado Networks |
| Nordic Semiconductor ASA |
| Novamint |
| NTT DoCoMo |
| Philips International B.V. |
| Reliance Jio |
| Samsung |
| Sateliot |
| Sequans |
| Siemens |
| Sierra Wireless |
| Telecom Italia |
| TNO |
| Verizon UK Ltd.  |
| Vodafone |
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