**3GPP TSG RAN Meeting #105 RP-242xxx**

**Melbourne, Australia, September 9-12, 2024** (revision of RP-242336)

**Source: Iridium Satellite**

**Title: New WID on Further Enhancements to NB-IoT NTN**

**Document for: Approval**

**Agenda Item: 10.1.2**

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: **Further Enhancements to NB-IoT NTN**

Acronym: TBD

Unique identifier: TBD

NOTE: For new WIs/SIs leave the Unique identifier empty and make a proposal for an Acronym.

 For a revised WI/SI: Take Unique identifier and acronym as shown in 3GPP workplan.

 If this is a RAN WID including Core and Perf. part, then Title, Acronym and Unique identifier refer to the feature WI.

 Please tick (X) the applicable box(es) in the table below:

 Either:

|  |  |
| --- | --- |
| **This WID includes a Core part** | **X** |
| **This WID includes a Performance part** | **X** |

 or:

|  |  |
| --- | --- |
| **This WID includes a Testing part** |  |
| **and it addresses the following 3GPP work area:** | **Radio Access** |  |
| **Core Network** |  |
| **Services** |  |

Potential target Release: Rel-19

NOTE: In case of contradiction with the target dates of clause 5, clause 5 determines the target release.

# 1 Impacts

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

# 2 Classification of the Work Item and linked work items

### 2.1 Primary classification

This description is either a …

|  |  |
| --- | --- |
|  | Study Item |

or a

|  |
| --- |
| Normative Work Item:*tick applicable boxes below* |
|  | Stage 1 |
| X | Stage 2 |
| X | Stage 3 |
|  | Other (e.g. testing) |

### 2.2 Parent Work Item

For a brand-new topic, use “N/A” in the table below. Otherwise indicate the parent Work Item.

|  |
| --- |
| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
| N/A |  |  |  |

NOTE: RAN agreed some time ago, that it describes the feature WI + Core/Perf. part WI or Testing part WI in one WID. Therefore, the table above should include the feature WI data (In case the feature covers Core and Perf. part, please list under Working Group the leading WG of the Core part).

### 2.3 Other related Work Items and dependencies

|  |
| --- |
| Other related Work Items (if any) |
| Acronym | Unique ID | Title | Nature of relationship |
| FS\_NR\_nonterr\_nw | 750040 | Study on NR to support non-terrestrial networks | The proposed WID will make use of the channel model defined by the FS\_NR\_nonterr\_nw study  |
| FS\_NR\_NTN\_solutions | 800099 | Study on solutions for NR to support non-terrestrial networks | The proposed WID will leverage solutions identified in FS\_NR\_NTN\_solutions to address some of the key issues associated to NTN |
| LTE\_NBIOT\_eMTC\_NTN | 920169 | NB-IoT/eMTC support for Non-Terrestrial Networks | The proposed WID will use the Release 17 specification resulting from this work as a baseline for the evolution |
| [IoT\_NTN\_enh](https://www.3gpp.org/DynaReport/WiSpec--941004.htm#_blank) | 941004 | IoT NTN enhancements | The proposed WID will use the Release 18 specification resulting from this work as a baseline for the evolution |
| IoT\_NTN\_Ph3 | 1020096 | Non-Terrestrial Networks (NTN) for Internet of Things (IoT) Phase 3 | The proposed WID will use the Release 19 specification resulting from this work as a baseline for the evolution |

NOTE: Also related or dependent WIs/SIs in other TSGs shall be indicated here.

# 3 Justification

This Work Item Description proposes the introduction of a new feature, dubbed “NB-IoT Periodic Carrier Availability” (NPCA), in NB-IoT NTN. This feature allows the operator to configure the usage of the radio resources to a periodic subset of the UL and DL subframes in N radio frames to save energy in the SAN (Satellite Access Node). This feature offers several key advantages:

1. Extend 3GPP IoT NTN Rollout with support for additional NGSO satellite systems:

The NPCA feature will benefit the entire ecosystem and extend the deployment of NB-IoT NTN, by extending support to additional existing, in-orbit satellite resources, in particular additional existing Non-Geostationary Satellite Orbit (NGSO) systems, and including enabling additional lower-complexity satellite payloads, such as implementations without diplexer. With this proposed feature, there is a significant opportunity to further expand global NB-IoT NTN service coverage. This includes providing connectivity to polar regions.

1. Improve Satellite Network Energy Saving:

Implementing NPCA involves reducing the number of contiguous UL and DL subframes in N radio frames to a periodic pattern that is respected by the SAN and UE. When activated, this reduces energy consumption per carrier and thus reducing satellite payload power consumption.

This NPCA feature should be designed leveraging the FDD operation, for NGSO operating in 1616-1626.5MHz, assuming this band will be defined as unpaired spectrum in 3GPP. (This band will be defined by a future spectrum-related work item). This will define a TDD mode for NTN systems.

Note: The principles of this feature may be of interest to other NTN deployment scenarios (such as NGSO and GSO operating in paired spectrum (i.e. E-UTRA operating bands for satellite access). These may be considered for inclusion in future releases.

The intent is to leverage existing NB-IoT NTN capable UEs, which today are half-duplex FDD devices.

# 4 Objective

### 4.1 Objective of SI or Core part WI or Testing part WI

The work item aims to specify essential enhancements for NB-IoT NTN with the following goals:

* Define a new TDD mode for NTN based on NB-IoT NTN FDD frame structure and procedures for the NB-IoT operation in the targeted MSS allocated band.
	+ This TDD mode includes the NPCA feature, which allows the operator to configure the usage of radio resources to a periodic subset of the UL and DL subframes in N radio frames. The periodic pattern should consist of usable contiguous UL subframes and usable contiguous DL subframes, which is periodic every N radio frames, which is referred to as NPCA (NB-IoT Periodic Carrier Availability)

The following baseline assumptions are to be considered:

* LEO @600 km and @1200 km orbit respectively, with set-1 satellite parameters as reference scenarios (See 3GPP TR 36.763)
* Target the 1616-1626.5 MHz
* Prioritize standalone deployment (i.e. operating in carrier(s) used only for NB-IoT)
* Operate with Earth fixed Tracking area, with either Earth fixed cells or Earth moving cells for NGSO
* Allow N to take an operator-defined, system-wide integer value in the range of 4 to 10, which may be further restricted as an outcome of the study.
1. Study the following:
* Study the impact of 10 contiguous sub frames in Tx and 10 contiguous sub frames in Rx over N radio frames on the UE downlink synchronization, when the NPCA feature is enabled [RAN1]

Specify the TDD NTN mode, including:

* Parameters to define the pattern of usable contiguous UL subframes and usable contiguous DL subframes, which is periodic every N radio frames [RAN1]
* The expected UE and SAN behavior for suspending transmission/reception, associated with operating within this pattern [RAN1]
* Modifications to timer values, if needed [RAN2]
* The mechanism to communicate the usable UL/DL pattern to UEs [RAN2]
* Updates to RRM core requirements, if needed [RAN4]

### 4.2 Objective of Performance part WI

NOTE: Leave empty if the WI proposal does not contain a RAN performance part.

* Updates to RRM performance requirements, if needed [RAN4]
* Define necessary demodulation requirements [RAN4]

### 4.3 RAN time budget request (not applicable to RAN5 WIs/SIs)

NOTE: For all new RAN related WIs/SIs which are not led by RAN WG5 the WI/SI rapporteur has to fill out the attached Excel table to request time budgets for corresponding RAN WG meetings.
The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI.
One time unit (TU) corresponds to ~ 2 hours in the meeting.
If no TU is needed, then leave the field empty otherwise enter a number >0 in the field.

 For revisions of already approved WI/SI descriptions: Please remove the Excel table from the WID/SID's zip file. The time budgets are already recorded. If you want to modify them, then this has to be done via the status report and not via a revised WID/SID.

 If this WID is covering Core and Performance part, then please fill out one line for each part in the attached Excel table.

**additional comments to the time budget request in the attached Excel table:**

# 5 Expected Output and Time scale

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

NOTE: If this is a RAN WI including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
By default a new specs can only be new for one of both parts.

| **Impacted existing TS/TR** |
| --- |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| TS 36.211 | LTE; Physical channels and modulation | RAN#108 | Core part |
| TS 36.213 | LTE; Evolved Universal Terrestrial Radio Access (E-UTRA);Physical layer procedures | RAN#108 | Core part |
| TS 36.300 | LTE; Overall description; Stage-2:  | RAN#109 | Core part |
| TS 36.304 | LTE; User Equipment (UE) procedures in idle mode and in RRC Inactive state | RAN#109 | Core part |
| TS 36.306 | LTE; User Equipment (UE) radio access capabilities | RAN#109 | Core part |
| TS 36.321 | LTE; Medium Access Control (MAC) protocol specification:  | RAN#109 | Core part |
| TS 36.331 | LTE; Radio Resource Control (RRC); Protocol specification | RAN#109 | Core part |
| TS 36.133 | LTE; Requirements for support of Radio Resource Management | RAN#109 | Core part |
|  |  |  |  |
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|  |  |  |  |

NOTE: If this is a RAN WI including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
If an existing spec is affected by both (Core part and Perf. part), then it has to be listed twice with appropriate approval dates.

# 6 Work item Rapporteur(s)

*TBD*

NOTE: The first listed Rapporteur has the overall responsibility for this WI (incl all secondary tasks).

# 7 Work item leadership

RAN1

Secondary responsible Working Group(s): RAN2, RAN4 (if needed)

# 8 Aspects that involve other WGs

None so far.

NOTE: For RAN WIs: Section 8 applies only to WGs outside of TSG RAN because all RAN WG aspects have to be covered in section 4.

# 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| Iridium Satellite |
| CCL (Cambridge Consultants) |
| Continental AG |
| ETRI |
| ESA (European Space Agency) |
| Deutsche Telekom |
| FirstNet |
| Fraunhofer HHI |
| Fraunhofer IIS |
| Gatehouse |
| Google |
| IIT Hyderabad |
| KT (Korea Telecom) |
| Mavenir |
| Midwave Wireless |
| NOKIA |
| Nordic Semi |
| OPPO |
| Qualcomm |
| Sateliot |
| Semtech |
| SES (Société Européenne des Satellites) |
| Sony |
| Telit |
| TELUS |
| Thales |
| TNO (Netherlands Organisation for Applied Scientific Research) |
| TOYOTA InfoTechnology Center |
| VIAVI |