**3GPP TSG RAN Meeting #105 RP-24xxxx**

**Melbourne, Australia, September 9-12, 2024** (revision of RP-242415)

**Source: Iridium Satellite LLC**

**Title: Revised WID on introduction of IoT-NTN TDD mode**

**Document for: Approval**

**Agenda Item: 10.4.5**

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: **Introduction of IoT-NTN TDD mode**

Acronym: IoT\_NTN\_TDD

Unique identifier: 1050123

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 |
| **Don't know** | X |  |  | 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 | This WI enhanced the IoT usage via NTN in Rel-17 LTE |
| [IoT\_NTN\_enh](https://www.3gpp.org/DynaReport/WiSpec--941004.htm#_blank) | 941004 | IoT NTN enhancements | This WI enhanced the IoT usage via NTN in Rel-18 LTE |
| IoT\_NTN\_Ph3 | 1020096 | Non-Terrestrial Networks (NTN) for Internet of Things (IoT) Phase 3 | This REL-19 WI IoT\_NTN\_Ph3 is enhancing IoT usage via NTN based on FDD so it is a parallel enhancement to the present WI but no dependencies between WIs are expected |

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 that allows the operator to use the radio resources in a periodic subset of the UL and DL subframes in N radio frames to achieve TDD operation in the SAN (Satellite Access Node) and IoT NTN UE, thus limiting power consumption. This feature allows extending 3GPP NB-IoT NTN operation with support for additional NGSO satellite system.

The new feature will 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.

This new feature should be designed leveraging commonalities with the NB-IoT FDD NTN operation, for NGSO operating in 1616-1626.5MHz, assuming this band will be defined as unpaired spectrum in 3GPP. This will define a TDD mode for NB-IoT NTN systems. The feature is not intended to be applicable to existing 3GPP bands.

# 4 Objective

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

The work item aims to specify enhancements for NB-IoT NTN to enable NTN operation with a NB-IoT TDD mode leveraging commonalities with half-duplex NB-IoT FDD NTN, by defining a new NB-IoT TDD mode for NTN based on minimum necessary changes to the NB-IoT NTN FDD frame structure and procedures for the NB-IoT operation in the targeted unpaired MSS allocated band (TN deployment is not expected in this band). The feature is not intended to be applicable to existing 3GPP bands.

The study and work objectives assume the following:

* 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 MSS allocated band
* Standalone deployment with anchor and non-anchor carriers (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
* The new NB-IoT NTN TDD mode allows configuring the usage of radio resources in the targeted MSS allocated band with a periodic subset of the UL and DL subframes in N radio frames. The periodic pattern should consist of non-overlapping set of usable contiguous UL subframes (U) and set of usable contiguous DL subframes (D), and guard periods, which is periodic every N radio frames, with N=9 for the target MSS allocated band.

This work item includes the following objectives:

* Specify a new NB-IoT TDD NTN mode based on minimum necessary changes to the NB-IoT NTN FDD frame structure and procedures, including:
	+ Definition, configuration (if needed) and signaling (if needed) of the periodic pattern, necessary adaptation and associated UE procedures [RAN1, RAN2]
	+ Support a pattern with a period of 9 radio frames for the target MSS allocated band, where D=U=8 with a default fixed guard period between D and U subframes, and with a configurable guard period between D and U subframes after RRC connection.Other necessary impacts on higher layers [RAN2]
	+ RRM and RF core requirements [RAN4]
		- Note: RAN4 work to be aligned with RAN1 assumptions.
* Specify a new NB-IoT TDD operating NTN band for the MSS allocation spanning 1616-1626.5 MHz for DL and UL, based on the outcome of the study, to be used as example band for this WI [RAN4].
	+ Specify band numbering
	+ Specify SAN and UE RF characteristics
	+ Specify DL and UL channelization.
	+ Specify channel bandwidth as 200 kHz
	+ Note1: No NTN-NTN coexistence study needed.
	+ Note2: Leverage existing work as much as possible for TN-NTN coexistence of adjacent bands

Note3: Reuse the existing RAN4 requirements as much as possible (no intention to have any relaxation of the RF emissions requirements)

### 4.2 Objective of Performance part WI

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

Specify the following:

* RRM performance requirements, as needed [RAN4]
* Necessary SAN and UE demodulation requirements [RAN4]
* SAN conformance testing 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.

Note: whether a new or an existing TR will be used will be discussed at RAN#106.

| **Impacted existing TS/TR** |
| --- |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| TS 36.211 | Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation | RAN#108 | Core part |
| TS 36.213 | Evolved Universal Terrestrial Radio Access (E-UTRA); Evolved Universal Terrestrial Radio Access (E-UTRA);Physical layer procedures | RAN#108 | Core part |
| TS 36.300 | Evolved Universal Terrestrial Radio Access (E-UTRA); Overall description; Stage-2:  | RAN#109 | Core part |
| TS 36.304 | Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode and in RRC Inactive state | RAN#109 | Core part |
| TS 36.306 | Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities | RAN#109 | Core part |
| TS 36.321 | Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification:  | RAN#109 | Core part |
| TS 36.331 | Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification | RAN#109 | Core part |
| TS 36.133 | Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of Radio Resource Management | RAN#109 | Core part |
| TS 36.133 | Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of Radio Resource Management | RAN#111 | Perf Part |
| TS 36.102 | Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception for satellite access | RAN#109 | Core part |
| TS 36.102 | Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception for satellite access | RAN#111 | Perf Part |
| TS 36.108 | Evolved Universal Terrestrial Radio Access (E-UTRA); Satellite Access Node radio transmission and reception | RAN#109 | Core part |
| TS 36.108 | Evolved Universal Terrestrial Radio Access (E-UTRA); Satellite Access Node radio transmission and reception | RAN#111 | Perf Part |
| TS 36.181 | Evolved Universal Terrestrial Radio Access (E-UTRA); Satellite Access Node conformance testing | RAN#111 | Perf part |
|  |  |  |  |
|  |  |  |  |

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)

*Andjela Savoia, Iridium, Andjela.Savoia@iridium.com*

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

# 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 |
| Huawei |
| HiSilicon |
| III |
| IIT Hyderabad |
| InterDigital |
| KT (Korea Telecom) |
| LG Electronics |
| Mavenir |
| MediaTek |
| Midwave Wireless |
| NOKIA |
| Nordic Semi |
| OPPO |
| Qualcomm |
| Samsung |
| Sateliot |
| Semtech |
| SES (Société Européenne des Satellites) |
| Sony |
| Telit |
| TELUS |
| Thales |
| TNO (Netherlands Organisation for Applied Scientific Research) |
| TOYOTA InfoTechnology Center |
| VIAVI |
| vivo |