3GPP TSG RAN Meeting #104 RP-241652

**Shanghai, China, 17th – 20th June 2024**

**Source: Intelsat, Eutelsat Group, Thales, CHTTL, Hispasat**

**Title: New WID on Introduction of Ku Band for NR NTN**

**Document for: Approval**

**Agenda Item: 9.1.5 Proposals led by RAN4 (spectrum related)**

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: New WID on Introduction of Ku Band for NR NTN

Acronym: TBD

Unique identifier: TBD

Potential target Release: Rel-19

# 1 Impacts

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

# 2 Classification of the Work Item and linked work items

## 2.1 Primary classification

### This work item is a …

|  |  |
| --- | --- |
|  | Study |
|  | Normative – Stage 1 |
|  | Normative – Stage 2 |
| **X** | Normative – Stage 3 |
|  | Normative – Other\* |

**\* 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 |  |  |  |

### 2.3 Other related Work Items and dependencies

|  |  |  |
| --- | --- | --- |
| Other related Work /Study Items (if any) | | |
| Unique ID | Title | Nature of relationship |
| 941006 | NR NTN (Non-Terrestrial Networks) enhancements | The present WID will leverage where appropriate aspects of the work on NTN VSAT above 10 GHz (e.g. coexistence study in FR2 between NTN and TN) |

# 3 Justification

The Ku band is allocated for primary satellite use for ITU regions 1, 2 and 3. Consequently, this WID introduces the Ku band into 3GPP specifications according to the ITU definitions in Table 1 and Table 2.

Table 1: Ku Band Downlink and Uplink Spectrum for ITU Regions 1 and 3

|  |  |  |
| --- | --- | --- |
| Ku band for GSO and Non GSO Space Segment | Downlink (Space to Earth) | 10.70 - 12.75 GHz |
| Uplink (Earth to Space) | 12.75-13.25 GHz & 13.75-14.5 GHz |

Table 2: Ku Band Downlink and Uplink Spectrum for ITU Region 2

|  |  |  |
| --- | --- | --- |
| Ku band for GSO and Non GSO Space Segment | Downlink (Space to Earth) | 10.70 - 12.70 GHz |
| Uplink (Earth to Space) | 12.70-13.25 GHz & 13.75-14.5 GHz |

Note: WRC-23 did not allocate mobile services in the Ku band.

Figures 1 and 2 show the respective frequency allocations graphically.

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Description automatically generated

**Figure 1: Ku band allocation for ITU regions 1 and 3**

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**Figure 2: Ku band allocation for ITU region 2**

The Ku Band is heavily used by satellite operators to provide broadband connectivity including but not limited to fixed, nomadic and vehicle mounted devices for the support of a variety of B2C and B2B applications. These applications include consumer and business broadband, cellular backhaul, and inflight connectivity as well as broadcast applications (e.g. in India to ESIM/MVSAT in 10.7 to 11.7, and Direct-to-Home/DTH in 11.7-12.5 GHz, and public warning and disaster recovery services in Japan). These legacy satcom systems use proprietary technologies that do not currently take advantage of 3GPP specifications.

With the definition of Ku band in 3GPP Specifications, future satellite networks will be able to inter-operate with the terrestrial mobile system under the 5G technology framework and provide coverage extension for broadband Machine-Type Communications devices.

The purpose of specifying Ku band in 3GPP is to enable NGSO and GSO satellite services operating in the Ku Band to use 3GPP 5G NTN standards rather than the currently used proprietary technologies.

The present Work Item will leverage the specification of Release 18 of the NTN Ka Band where appropriate, to reduce RAN4 workload [See also Ref R4-2305925 and RP-232694].

In order to benefit from the similarities with the Ka band specification work in Release 18, the following approach for the Ku band is considered:

* Extend the definition of FR1-NTN and/or FR2-NTN Frequency Range as required   
  (Note: This does not affect the current TN FR1/FR2 definitions, and is not supposed to apply to future terrestrial bands defined in the Ku frequency range)
* Reuse Ka band coexistence study assumptions as much as possible, with modifications where necessary, e.g. for frequency range and subcarrier spacing, to ensure that Ku Band for NTN shall not impact specifications of services operating in adjacent bands and shall not cause degradation to services in adjacent bands including 3GPP-specified bands adjacent to the targeted Ku band. It is assumed that the adjacent band coexistence study will be performed at the Ku band edges.

The Ku band comprises two non-contiguous uplink frequency blocks, and since there is no requirement for devices to simultaneously transmit in both uplink blocks, two Ku bands will be specified using the single downlink block and a single uplink block, which is consistent with legacy FDD band definitions.

Due to ongoing regulatory studies in the US (FCC) which are considering using the 12.7 GHz – 13.25 GHz frequency range for terrestrial services, it is proposed to conduct the Ku Band Normative work taking into account the ongoing FCC studies as shown in Figure 3 and Figure 4:

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**Figure 3. Normative work for Ku band #1 for all ITU regions**

A diagram of a network

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**Figure 4. Normative work Ku band #2 for all ITU regions excluding US in Region 2**

The potential impact of a VSAT testability study on how Ku band VSAT core and performance requirements might be defined is not in this WID scope.

Note: The Release 18 NTN scope for operation above 10 GHz, does not support Mobile VSATs (ESIMs) connected to NGSO Satellites. This may be considered at a later date.

# 4 Objective

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

The following assumptions are taken as the baseline for this work:

* GSO and NGSO
* NTN capable UE type 1 to 5 (38.101-5 Table 9.2.1.0-1) for above 10 GHz (no handheld devices)
* FDD Mode
* GNSS Receiver capability

The objectives are:

* Use the regulation requirements in ITU Regions 1, 2 and 3 to identify relevant adjacent band co-existence scenarios for NTN Ku Band covering the following frequency ranges, considering targeted deployment scenarios:
  + For all ITU regions:
    - Downlink 10.70 – 12.75 GHz
    - Uplink 13.75-14.5 GHz
  + For all ITU regions excluding US in Region 2
    - Downlink 10.70 – 12.75 GHz
    - Uplink 12.75 - 13.25 GHz & 13.75-14.5 GHz
  + Note: Appropriate TX/Rx separation for uplink downlink pairing will be required.
* Update coexistence study. Reuse Ka band coexistence study assumptions as much as possible, with modifications where necessary, e.g. for frequency range. Conduct new co-existence studies based on adjacent services (see R4-2400510 for example).
* Specify RF requirements for satellite access node and NTN VSAT types in 38.101-5 also considering existing regulations on antenna sizes for certain parts of the Ku band.
* Specify RRM requirements to cover the Ku band using Ka band starting with the assumptions from RP- 232694.
* As a first priority for all ITU regions, define Ku band #1 for the downlink block and uplink block B with the aim of supporting satellite services in 125 MHz (UL) and 250 MHz (DL) aggregated bandwidths. Two potential approaches for achieving this shall be studied, from which one shall be selected:
  + Ku band #1 as FR1-NTN supporting 20 MHz, 35 MHz, 50 MHz, 70 MHz and 100 MHz channel bandwidths with 30 kHz subcarrier spacing
  + Ku band #1 as FR2-NTN supporting 50 MHz, 100 MHz, 200 MHz, 400 MHz channel bandwidths with 120 kHz subcarrier spacing
  + RAN4 will select which one of the above approaches will be pursued by RAN #106.
* As a second priority for all ITU regions excluding the US in region 2, using the same approach, define Ku band #2 for the downlink block and uplink block A to support satellite services in 125 MHz (UL) and 250 MHz (DL) aggregated bandwidths.

## 4.2 Objective of Performance part WI

The objective of the performance part is to update as appropriate for Ku band:

* RRM performance requirements and test cases
* UE demodulation and CSI reporting requirements
* Satellite access node demodulation requirements
* Satellite access node conformance tests

## 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# | Rapporteur |

|  |  |  |  |
| --- | --- | --- | --- |
| Impacted existing TS/TR {One line per specification. Create/delete lines as needed} | | | |
| TS/TR No. | Description of change | Target completion plenary# | Remarks |
| TR 38.863 | NR; Solutions for NR to support non-terrestrial networks (NTN):  Non-terrestrial networks (NTN) related RF and co-existence aspects | RAN#108 | Study part |
| TS 38.101-5 | Support for a new NTN band | RAN #109 | Core part |
| TS 38.133 | Support for a new NTN band | RAN #109 | Core part |
| TS 38.108 | Support for a new NTN band | RAN #109 | Core part |
| TS 38.101-5 | Support for a new NTN band | RAN #111 | Perf part |
| TS 38.133 | Support for a new NTN band | RAN #111 | Perf part |
| TS 38.181 | Support for a new NTN band | RAN #111 | Perf part |

# 6 Work item Rapporteur(s)

Soghomonian, Manook, Intelsat, [Manook.soghomonian@intelsat.com](mailto:Manook.soghomonian@intelsat.com)

# 7 Work item leadership

Primary responsible Working Group: RAN WG4

# 8 Aspects that involve other WGs

None

# 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| Intelsat |
| Thales |
| Eutelsat Group |
| JSAT |
| Lockheed Martin |
| Airbus |
| Hispasat |
| Sateliot |
| Viavi Solutions |
| Panasonic |
| Gilat |
| Gatehouse |
| Omnispace |
| Fraunhofer IIS |
| Fraunhofer HHI |
| TTP |
| Rohde & Schwarz |
| ESA |
| Sequans |
| Mitsubishi Electric |
| InterDigital |
| Catapult |
| Keysight Technologies |
| SyncTechno |
| Tejas Networks |
| Sharp |
| SES |
| Deutsche Telekom |
| CHTTL |
| Softbank |
| ETRI |
| LG Electronics |
| Novamint |