3GPP TSG-RAN Meeting #104 RP-24xxxx

June 17th ‒ 20th, 2024

Shanghai, CN

**Agenda item:** 9.1.5

**Source:** Moderator (RAN4 vice chair, Qualcomm Incorporated)

**Title:** Moderator's summary for Ku band

**Document for:** Information

# Introduction

This document provides a summary of discussion for initiating a work item to define specifications for a new NR frequency band in the Ku frequency range.

# Issues

A proposed work item description was provided in [1]. The objectives are copied below

The objectives are:

Phase 1

* Update coexistence study if needed [RAN4]
* 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 [RAN4]:
  + Downlink 10.70 – 12.70/12.75 GHz
  + Uplink 12.75-13.25 GHz (excluding US in region 2) & 13.75-14.5 GHz
* Specify RF requirements for satellite access node and relevant NTN VSAT types considering existing regulations on antenna sizes for certain parts of the Ku band. [RAN4].
* Specify RRM requirements to cover the Ku band. [RAN4]
* In addition to legacy channel bandwidths, support new channel bandwidths to align with typical existing Ku band operational constraints [RAN4]
* Study and specify enablers for half duplex FDD mode [RAN1]
  + Rational: Interference mitigation for uplink 12.70 GHz – 13.25 GHz being adjacent to 10.70 GHz– 12.70 GHz downlink

Phase 2

* Extend the phase 1 normative work to include uplink band 12.70 GHz – 13.25 GHz for the US in Region 2

## Coexistence

Is a coexistence study needed in additional to the coexistence study already conducted for Ka band? If additional study is needed, what aspects different from the Ka band study should be considered?

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| Company | Comment |
| Charter Comm Inc | From our perspective, we would like to suggest waiting until the FCC rules before approving the WID. There is a current an FCC NOI considering 12.75-13.25 GHz as Mobile Wireless Spectrum. Until this NOI is completed, we should hold off in this work. Furthermore, in RAN3101, Intelsat provided a tdoc, RP231886 which proposed to hold this work until RAN#105 (Sept 2024). In this meeting, there was also a tdoc which was approved, RP232668, RAN4 New Proposals for Rel-19 in which RP231886 was withdrawn. |
| Ericsson | Yes, co-existence study should be considered as the frequency is substantially different to Ka band. |
| Huawei/HiSilicon | *Update coexistence study if needed [RAN4]*  In the above objective, it is not clear which co-ex is supposed to be updated – this should be clarified in the WID. |
| T-Mobile USA | It is difficult to say what coexistence work would be needed since the regulations for 12.75-13.25 are not finalized for the US. We agree with Charter that it would be best to wait for US regulations. Also, if one operator is using the UL above 12.7GHz and another the DL below 12.7 GHz, UL-DL coexistence is problematic, and something that RAN4 has in the past not addressed. The half-duplex proposal doesn’t really address this unless there is tight coordination between the satellite operators. |
| Nokia | We do not have the coexistence to update in RAN4. The scope of new coexistence study should be further clarified. |
| Intelsat | Coexistence studies should be conducted with terrestrial services close to and adjacent to the Ku band’s DL an UL Band |
| Samsung | We can leverage Ka band co-existence study in Rel-18 as much as possible i.e., simulation assumption (basic parameters) and methodology.  But additional co-existence study is still required due to the frequency range difference compared to Ka band.   * Ka band: 17GHz/DL, 27GHz/UL (within FR2 range) used for co-existence evaluation * Now Ku band is totally with in FR3 range for DL(~12GHz) and UL(~14GHz).   The expected assumption on TN ACLR/ACS can also be different compared to Ka band especially for UL part. |
| ESA | At the moment, there are no adjacent TN bands defined, thus in our view very light co-existence study shall be performed. Similar Ka-band assumptions can be done to speed up the work. |
| Thales | Given that there are no defined adjacent TN bands, it is difficult to determine which coexistence study shall be conducted. |
| Hispasat | No need to further coexistence studies since for the time being there is no adjacent TN bands |
| Eutelsat Group | Due to the frequency difference from Ka, some additional co-existence work is necessary. This can proceed in phase 1 for all regions excluding the US. |
| CHTTL | We also think at this current stage there is no need to do the further coexistence studies, since there is no adjacent TN bands currently, if in the future there is planned frequency for TN, it can be further updated. Maybe the work can be focused on region 1 & 3 first. |
| Airbus | As mentioned by other proponents, there is no current adjacent TN bands defined next to \_Ku band. So, if a band needs to be defined for coexistence studies, similar assumptions need to be taken from Ka band coexistence study done in Rel. 18 |
| LGE | We are fine to check the necessity of coexistence and then start coexistence if needed during WI phase. And reminding coexistence study usually takes some time, we think other objectives can start simultaneously not pending on the results of co-existence if other tasks are independent from co-existence study. |
| New H3C | Need check necessity of coexistence studies |

Possible way forward:

Reuse Ka band coexistence study with updates for frequency range. It is not within the scope of this work item to newly evaluate coexistence with adjacent TN band.

## Regional applicability

Recognizing the ongoing consultation in the US regarding the frequency range 12.70 – 13.25 GHz in the US, the proponents of [1] have suggested to structure the work item in two phases. The first phase of the work item would define requirements only for Region 1 and Region 3 countries as well as Region 2 countries not including the US. The second phase commencing after conclusion from the FCC would potentially extend the 12.70 – 13.25 GHz to the US as well. Yet, other companies preferred to discuss the 12.70 – 13.25 GHz altogether for all regions, only after conclusion from the FCC to allow the possibility of enabling a common band and/or common requirements worldwide.

A diagram of a network

Description automatically generated with medium confidence

**Figure 3. Phase 1: Normative work for ITU regions excluding US**

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**Figure 4. Phase 2: Additional normative work for US**

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| Company | Comment |
| Ericsson | UL A for Region 2 should only be started when the FCC consultation has progressed. It may be preferable for all regions to work on DL and UL B first in order to end up with a harmonized band plan if possible. |
| Huawei/HiSilicon | One practical approach to decide which way to go, may be to compare how many new bands would be need to be introduced for each of the two options on table (2 phases, vs postponing till FCC conclusion for 12.70 – 13.25 GHz). |
| T-Mobile USA | We think it is premature to propose additional normative work for the US. We also don’t understand the Figures above. If Figure 3 includes Normative work for the ITU regions excluding the US, and Phase 2 is additional normative work for the US, does that mean that the US will consist of only an uplink from 12.70-13.25 with no downlink? I don’t think that is the intention, because it is different than what is said in the objectives. It seems like Figure 3 is really two figures. The top one would be the Normative work for ITU regions excluding the US, and the second figure would represent the Normative work for the US, and Figure 4 represents the additional normative work for the US. Is this correct?  We would prefer that the work only include Region 1 and Region 3, and wait for Region 2 until the regulatory situation is clear. |
| Nokia | As the regulatory requirement is unclear for now, Phase 2 (Region 2 work) should be removed from the objective. |
| Intelsat | Standardization work on UL Band A should commence once FCC’s position is clarified in due course. A two-phase approach is proposed to accommodate for FCC’s considerations.  Removal of the entire region 2 is unreasonable and unnecessary as the FCC public consultation is only on small part of the Ku band and in US only not in the entire Region 2 |
| Samsung | We aware the concern from US operators due to FCC situation on 12.70-13.25 GHz. Phase by phase approach could be good way to address this. One possible way as suggested by Ericsson, we first focus on common frequency ranges across all regions and countries i.e. DL 10.7-12.7 GHz and UL 13.75 -14.5 GHz . With above band definition, FDD mode also possible with enough Tx-Rx separation. |
| ESA | In line with the proponents, the phase 1 shall not be impacted and start as soon as possible. Phase 2 will start when FCC would have provided guidelines. |
| Thales | Phase 2 may be carried out later, however this sub-band is allocated to satellite services in other ITU regions. Therefore, the use of these bands in the rest of the world shall not be penalized. |
| Hispasat | Why should we penalize the entire region 2 if the FCC consultation only applies to the US? We would agree to remove phase 2 while maintaining phase 1 for all regions except the US. |
| Eutelsat Group | Agree with Ericsson and others that the work should commence now in all regions excluding the US. One country cannot hold up the entire industry with a process that has no defined end point. The clarity of the figures can be improved. The text in the objectives is clear. |
| CHTTL | We think the work for region 1 & 3 can be started first, we are ok to focus on common frequency ranges across all regions and countries i.e. DL 10.7-12.7 GHz and UL 13.75 -14.5 GHz. |
| Intel | Prefer to exclude the frequency range 12.70 – 13.25 GHz for consideration at least for Region 2 (or US only). Additional updates can be made at a later stage once regulatory decisions are clear and we don’t think that Phase 2 needs to be included from the very beginning.  Also, agree with Ericsson and Samsung comments that one possible approach is to work on DL and UL B first across all regions. |
| Inmarsat | Irrespective of the frequency band or range of applicability, the notion of removing the entirety of Region 2 from a new band WI just on the basis of uncertainties with the US/FCC is very bad practice and should be avoided. This has already been attempted in the past with other bands but it’s a very bad approach. |
| Airbus | In our opinion, the work should start as soon as possible for all the regions except for US. Once FCC takes a decision, the phase 2 work can start. We agree on removing the phase 2 for now, and adding a new work item once FCC has finally made the decision. |
| LGE | Phase 2 can be removed and further discussed later after region 2 regulation is more clear. |
| New H3C | Removing phase 2 because he regulatory situation isn’t clear |
| Charter Communications Inc. | Starting with normative work on phase 1 and then later proceed with phase 2 might cause significant complications for 3gpp. This happen during normative work for n77, where because of delays with the FCC rulings on the band, it caused several changes to the specification to accommodate for the late rulings in the FCC. Specially if the current thought process in the NOI, suggest moving incumbents to the high end of the band clearing the low end of the band for Mobile Wireless. It is incumbent for 3GPP to wait for all Regions to complete regulatory rulings to alleviate later changes in premature normative work. Our opinion is to wait until RAN#105 and re-assess based on latest information from the NOI work in the FCC |
| CableLabs | We support the proposal from Ericsson – focus DL and UL B for all regions and remove UL A from the WID. |

Possible way forward:

Figure 3b for all regions. Figure 4 for Regions 1 and 3 with possible guard band to be studied.

## Channel bandwidths

The WID [1] suggests that new channel bandwidths aligned with typical existing Ku band operational constraints is needed. The addition of new channel bandwidths may require work outside of RAN4 as well as potential additional work inside RAN4. Moreover, the channel bandwidths have not been identified by the proponents.

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| Company | Comment |
| Ericsson | They could potentially be added in a second stage |
| Huawei/HiSilicon | Both “legacy” and new channel bandwidths shall be explicitly listed in the WID, so RAN4 is aware of the underlying work. It is not obvious what does the “legacy” mean in the current WID wording. Same for “*typical existing Ku band operational constraints*”. |
| T-Mobile USA | We think that the new channel bandwidths would make this work not spectrum related because generic requirements would be needed for the new channel bandwidths. We think the new channel bandwidths should be removed from the WID, and they can be added later.  In offline discussions with Intelsat we heard that the new channel bandwidth of interest is 36 MHz. Since we have not been able to get any new channel bandwidths that are not a multiple of 5 MHz for terrestrial (except for the almighty railroad interests who were able to get the 3 MHz channel bandwidth) we would suggest using the existing FR1 35 MHz channel bandwidth for the Ku Band. |
| Nokia | The required channel bandwidths must be clarified in the objectives. |
| Intelsat | FR1 and FR2 bandwidths can be used/re-used , above comment from T-Mobile can be explained further. |
| Samsung | To control overall workload in RAN4 and avoid potential impact to RAN1, we would like proponent companies clarify the target CHBW/SCS.sets.  We suggest to follow the same approach as Ka band, reusing existing TN FR2 CHBW/SCS sets.  Any new CHBW/SCS combination out of existing FR2/FR1 CHBW/SCS may bring additional work in RAN4/RAN1 e.g.   * New CHBW values within existing FR2 CHBW range e.g., within 50MHz ~200MHz (60kHz SCS), require additional work in RAN4 to specify reasonable SU * New CHBW outside of existing FR2 CHBW range e.g. >200MHz or <50MHz for 60kHz will bring impact to both RAN1 and RAN4 (shall be avoided) |
| ESA | The idea is to introduce channel bandwidth compatible with the existing satellite payload. Specific values can be defined in the objective. For instance, 30 MHz and 30kHz SCS. |
| Thales | The WID shall consider in priority the most relevant channel bandwidth, in any case shall be multiple of 5 MHz. |
| Eutelsat Group | The key legacy satellite bandwidths are 250 MHz for DL and 125 MHz for UL. These can be implemented using 120 kHz SCS for 250 MHz and 60 KHz SCS for 125 MHz. Existing SSB and PRACH will be used so the work can be completd within RAN4 without RAN1 involvement. These bandwidths are fundamental to the satellite industry and so considered essential to the initial specification of the Ku band. In addition, there are transponders using DVBS that use 36 MHz and 72 MHz. The 35 MHz NR bandwidth may be sufficient here. |
| CHTTL | Maybe we can start with channel bandwidths that are a multiple of 5 MHz first. |
| Intel | Further clarifications on target CBW/SCS are needed to assess the workload. The CBW shall be not go beyond the max/min CBW defined for NR. |
| Inmarsat | We think these additional channel bandwidths should be eventually applicable and thus common also for other NTN bands above 10 GHz (e.g. Ka bands n512, n511, n510 and future bands). |
| Airbus | We should reuse the bands being defined already for Ka band (50, 100, 200, 400 MHz). However, at least the bandwidths currently being used by satellites services in this Ku band can be also considered (125MHz and 250MHz) without impact on RAN1. |
| CableLabs | We agree to clarify what bandwidths are considered in this WID. Any new channel BW may require RAN1 involvement which should be deferred to September for the discussion of new RAN1 work. |

Possible way forward:

Proponents to create a channel bandwidth/SCS table so there is no uncertainty on what is being proposed. Only multiples of 5 MHz, new bandwidths are not in scope of this WI.

Lower bandwidths are compatible with FR1 numerology whereas wider bandwidths are compatible with FR2 numerology. One possibility is to create two bands for the same frequency range, one of which is FR1 band and another is FR2 band.

## Half duplex

The WID [1] proposes an objective to introduce a half duplex FDD mode for NR NTN. It is acknowledged that this would require participation from RAN1 and therefore extends the scope of this work item beyond spectrum.

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| Company | Comment |
| Ericsson | This is connected to the 12.75-13.25 range so could be delayed/removed, returned to later as needed. There may be some other RAN1/2 objectives as below. |
| Huawei/HiSilicon | It is not clear whether half duplex FDD applies for UE only or it applies to network as well. According to the description of rational, it seems half duplex FDD is needed for network. But it is not clear how Ku spectrum are assigned among satellite operators, whether DL spectrum and UL spectrum assigned to an operator are adjacent to each other or not, hence it is not clear whether some duplex enhancement for network is needed or not.  Before the scenario can be clarified, we would prefer RAN4 to study and conclude on the spectrum scenario before RAN1 proceed with any study/work. |
| T-Mobile USA | We think introducing a half-duplex mode to handle the uplink adjacent to the downlink that includes RAN1 work would make this a non-spectrum related Work Item and should be removed from the WID. It might be best to remove the 12.70-13.75 uplink from this WID. That and the deferral of new channel bandwidths would allow this to be a spectrum related Work Item. |
| Nokia | RAN1 impact should be removed and discussed separately. |
| Intelsat | Half duplex solution is required for low-end terminals, We already have half duplex terminals which are running in proprietary systems and we like to replace them with 5G/NR solutions |
| Samsung | We’d like to first clarify the deployment scenarios first:  -Whether only UE works in a HD-FDD mode, or both UE and NW work in HD-FDD mode?  -For the Regions support both UL A and UL B, whether UE treat UL A + UL B as one cell with non-contiguous carriers? Or UL A and UL B only can be treated as separate bands?  Before the usage and deployment scenarios especially on UL block A + UL block B to be clarified, it's hard to judge the expected RAN1 work and impact. |
| ESA | This topic can be deprioritized. |
| Thales | This topic can be postponed to future release. |
| Eutelsat Group | HD-FDD can be used for interference mitigation for uplink bnad A or more generally for lower cost terminals. For Eutelsat current and next generation, HD-FDD would only be required at the VSAT. The current system uses the entire downlink and part of uplink band B (14.0 – 14.5 GHz). |
| Intel | Prefer to focus on RAN4-centric requirements in this WI and remove objectives with RAN1 scope. HD-FDD and other potential L1 enhancements for NR NTN can be a part of discussion in RAN #105 (Sep 25) and shall be treated along with other proposals. |
| Inmarsat | We think these additional channel bandwidths should be eventually applicable and thus common also for other NTN bands above 10 GHz (e.g. Ka bands n512, n511, n510 and future bands). |
| New H3C | This topic should be deprioritized |
| Charter Communications Inc. | We agree with T-Mobile, best to remove the 12.70-13.75 uplink from this WID and the deferral of new channel bandwidths would allow this to be a spectrum related Work Item. |
| CableLabs | We agree with T-mobile and Charter. |

Possible way forward:

Remove the half duplex from this WI.

## Other issues

Any other issues?

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| Company | Comment |
| Ericsson | There is a need to check and decide whether the new band should inherit characteristics of FR1 FR2 or a newly defined range. This should consider not just RAN1, but also RAN1 aspects such as SCS, SSB, PRACH etc. If the range is not FR1 or FR2, some RAN1/2 spec and signaling changes are needed.  Suggest to add two objectives:  Check and confirm which FR the band is part of [RAN4, RAN1]  IF necessary, specify new NTN specific FR [RAN1, RAN2, RAN4]  Note: NTN FR does not impact decisions for TN FR for the 7-24GHz frequency range.  We that that we have an RRM objective in the WID. Its not clear what to do in RRM. Maybe better to come back later with RRM. |
| Huawei/HiSilicon | Reuse of the TR 38.863 may not be allowed by RAN Secretary. Please check. New TR may be needed instead (even if we would also prefer to reuse some of the existing TRs to capture Ku aspects). |
| Huawei/HiSilicon | Remove the following wording from the Justification:  *Note: Further to the Release 18 NTN scope for operation above 10 GHz, Mobile VSATs (ESIMs) connected to NGSO Satellites may be considered at a later date.*  Mobile VSAT for both Ka and Ku can be considered as non-spectrum item for Dec checkpoint. Besides, related Note is already captured in TS 38.101-5. |
| Huawei/HiSilicon | *Specify RF requirements for satellite access node and relevant NTN VSAT types considering existing regulations on antenna sizes for certain parts of the Ku band. [RAN4].*   * We suggest to clarify what are “*relevant NTN VSAT types*” to avoid unnecessary ambiguities. * Replace “existing regulations” with “applicable regulations” as the US regulation is not yet existing, while it is expected to be also applicable. * As “*certain parts*” is not very precise, suggest to simply remove it and keep “*for Ku band*”.   Is there any specific reason why we need to mention “*antenna sizes*” here? All applicable NTN VSAT regulations shall be reflected, i.e. not just those related to antenna sizes. |
| Nokia | RAN1/2 impact should be removed and discussed separately. |
| Intelsat | Mobile VSAT connectivity solution to NGSO can be considered at a later stage |
| Samsung | For RRM requirements, to control overall workload s, we suggest to follow the same assumption on RRM scope from Ka band in WF RP- 232694 given same VSAT types from Ka band will be applied Ku band as well. |
| Thales | It is important to start the standardization activities on Ku-band in this RAN meeting. |
| Eutelsat Group | The intention is to extend NTN FR2 down to 10.7 GHz which will not impact TN definitions. The existing Ka band work on RRM can be re-used. Mobiel VSAT to non GSO wil be brought forward in December 2024. Clarifications [roposed by Huawei/HiSilicon above are acceptable. |
| CHTTL | We share the same view that it is important to start the standardization activities on Ku-band in this RAN meeting. |
| Airbus | It is important to agree on Ku band activities starting in this meeting, once Ka band has already been finalized. The motivation paper (RP-241607) already exposes the business interest of such NTN band |
| LGE | Mobile VSAT with NGSO needs to be considered along with the UE type definition, i.e. whether we will use the existing UE type or define a new UE type for Mobile VSAT with NGSO.  Support Ku band WI start in Q3 2024. |

# Reference

1. RP-240938, “New WID on Introduction of Ku Band for NR NTN,” Intelsat, Eutelsat Group, Thales