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RAN

3GPP TSG RAN Meeting #94-e RP-212673

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Agenda Item: 8A.2

Source: RAN Vice-Chair (AT&T)

Title: Moderator's summary of discussion [RAN94e-R18Prep-13] NTN evolution

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The discussion in this thread covers the topic #13 in [RP-212657]. "**NTN (Non-Terrestrial Networks) evolution"**

The topic includes both NR & IoT (Internet of Things) aspects. At this time, it is not clear if there will be one WID to address both aspects or separate WIDs. This can be further discussed during the email discussion period.

Deadlines and NWM organization is based on the guidelines provided by the RAN Chair in [RP-212657]. Per the guidance, the goal of the email discussion is to focus on potential scope/areas for each potential WI or SI, with NO intention to update the set and the organization of the topics as endorsed in RP-212608.

1 Initial Round

The initial round will focus on taking the output of the RAN93e Rel-18 Prep in [RP-211658] and continuing to fine tune the scope/areas into a list of objectives with identified leading WG and secondary WGs for each objective as well as any potential interaction with SA/CT. We should not repeat discussions from RP-211658 and should focus on getting to a draft WID by the end of the email discussion period.

1.1 Collection of company views

1.1.1 Evolution of NR NTN (Non-Terrestrial Networks)

This section will focus on the consolidating the list of objectives for the Evolution of NR NTN. Each subsection will provide the initial set of objectives for areas that were previously discussed and summarized in RP-211658 for further refinement. **Companies should provide comments in the each associated feedback form to work towards a detailed set of objectives with proposed leading WG and secondary WGs for each objective as well as any potential interaction with SA/CT**. An initial proposal for impacted WG(s) is also provided.

1.1.1.1 Coverage enhancements

The list of possible objectives (as a starting point) is shown below and should be further refined during the email discussion. The goal will be to adapt the work from the general NR coverage enhancement WID and limit work to specific gaps for NTN.

- Define and specify repetitions and diversity techniques for the relevant channels (including PRACH and techniques to enable full-power UL transmission and reduced polarization loss) [RAN1]
- [Define relevant CSI aging mitigation] [RAN1]
- Define relevant DM-RS config [RAN1]
- Improve the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead [RAN1,RAN2] [Liaise with SA2/SA4 as necessary]
- Investigate means to mitigate packet interruption due to low DL/UL SNR and beam/cell switching for NTN [RAN2, RAN1]

Feedback Form 1: Coverage Enhancements

1 – Rakuten Mobile

There is scope for coverage enhancement in NTN specially use of repetition & diversity for UL.
Also we would like to see below topics to be part of NTN,
- Interference management between TN & NTN incase of Co-frequency case .

2 – THALES

We support this candidate enhancement in Rel-18.

We agree with this set of objectives but we propose to add another objective: "· Evaluate the coverage performance and identify the candidate channels that have coverage issues [RAN1]"

Leading WG = RAN1, Secondary WG = RAN2

Potential interaction with SA/CT: Interaction with SA2 & SA4 with respect to the potential low-rate codecs performance enhancements for in link budget limited context"

3 – Intelsat

We support this in Rel-18 and share Thales's views.

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

For now the listed objectives seem to be for general NR coverage enhancement. The Rel-18 NTN objectives shall focus on the applicability of the solutions developed by general NR coverage enhancement to NTN, and identify potential issues and enhancements if necessary, considering the NTN characteristics including large propagation delay and satellite movement.

- For the first bullet (Define and specify repetitions and diversity techniques…), considering that there are also discussing on support of PRACH repetition in coverage enhancement, it may be better to focus on NTN specific characteristics to avoid overlap with other topics (this issue is also being discussed in UL enhancements). We are fine to address the coverage enhancements for other channels that have been not been so far addressed or require NTN specific enhancements.

- Regarding CSI aging mitigation, our understanding is that the aging is due to large propagation delay in NTN, we would like some clarification on how to solve this issue. Our view is that the issue can only be compensated by some mechanism at UE side.
- Regarding DMRS configuration enhancement, our understanding is that DMRS configuration is already very flexible in NR specification. We are not sure what concrete enhancement is to be proposed here.

5 – vivo Mobile Communication Co.

The coverage enhancement areas are too diffuse, and it seems some areas are irrelative to coverage enhancement. We prefer to study and identify NTN specific coverage issues firstly, then focus on the most necessary enhancement areas.

For repetitions and diversity techniques enhancement, we suggest to separate them into independent bullets as follows:

- Study and specify repetitions enhancement other than Rel-17 CovEnh WI for the relevant channels [RAN1]
- Study and specify NTN specific diversity techniques for the relevant channels [RAN1]

For CSI aging mitigation, the benefit is unclear for coverage.

For DMRS related enhancements for coverage, Rel-17 CovEnh WI has discussed, but no enhancement is approved. Similarly, there is no strong motivation for coverage enhancement for NTN scenarios based on relevant DMRS config.

6 – Samsung Electronics Co.

We agree that coverage enhancement is one of the important aspects for NTN. If NTN-specific characteristics are the motivation of the coverage enhancement, then it can be studied in NTN work, otherwise it can be part of another WI (e.g., UL enhancement of coverage).

Improvements introduced in Rel-17 Coverage Enhancement for PUSCH/PUCCH/Msg3 should be considered applicable to NTN use case. Since PRACH enhancement is considered in Rel-18 UL enhancement work, we don't think it should be considered in Rel-18 NTN.

7 – Guangdong OPPO Mobile Telecom.

We agree to support the scope of coverage enhancement. While for detailed objectives, we share similar view with vivo on DMRS enhancement. The motivation should be justified.

8 – Spreadtrum Communications

Coverage enhancement is essential for smartphones which has low antenna gain. We support this objective for coverage enhancement. Assessment of the gap from R17 coverage enhancements should be included in this objective. Furthermore, CSI aging mitigation is not relevant to coverage enhancement, it was studied in Rel-16 SI and concluded that this can be mitigated by gNB implementation.

9 – ESA

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

10 – DOCOMO Communications Lab.

Considering large pathloss in NTN, coverage enhancement is an important objective. However, Rel-17 NR CovEnh WI has specified some enhancements on PUCCH/PUSCH, and PRACH enhancement for coverage

is now under discussion in Rel-18 NR UL enhancement. Hence, applicability of those NR solutions to NTN should be considered first. We can be flexible to have study item on whether enhancement is necessary or not, while direct work is NOT OK.

For each of possible objectives above,

- Repetitions and diversity techniques: as abovementioned, whether current spec is fine or not should be clarified first.
- Relevant CSI aging mitigation: The enhanced direction and spec. impact are not clear.
- Relevant DM-RS config: The motivation and enhanced direction are not clear, e.g., how to improve coverage by DMRS configuration.
- Improve the performance of low-rate codecs in link budget limited situation: Necessity is unclear as abovementioned. In addition, we do not see RAN1 impact.
- Investigate means to mitigate packet interruption: Same comment as the last one above.

11 – CATT

We support this in Rel-18 and share Thales's views.

12 – China Mobile Group Device Co.

Support the listed objectives, and agree with the comments from Thales.

13 – ZTE Corporation

For this aspect, the main intention is to improve DL/UL performance including smartphone and VSAT-like. A general study phase is expected to justify the potential solutions.

- Regarding the [CSI aging mitigation], it's critical to ensure the performance for LEO due to the higher mobility, at least in DL. The enhancement on the legacy report with additional content, e.g., deviation of CQI, can be considered with the following updates on the scope:
  - Identify and specify the additional CSI reporting content to mitigate the CSI aging
- For the DM-RS configuration, the overhead reduction in the frequency domain is preferred due to the Los-like channel in almost all scenarios. In addition, the potential power-boosting with a larger gain is beneficial to improve the accuracy of channel estimation. The following updates are preferred to clarify the scope:
  - Identify and specify the solution to reduce the DM-RS density in the frequency domain with additional power boosting.

For other solutions, it's mainly up to the link budget assumption, especially the UE assumption for evaluation.

14 – Beijing Xiaomi Mobile Software

We share the view that the first step is should be to have evaluation on the potential channels that may have coverage issues and identify the coverage gap in NTN scenario. Regarding the candidate solutions, we think increased repetition is surely can be considered as we have done in Rel-17 CE WI. For other candidate solutions, we are not sure about the exact meaning and benefits. Thus we prefer to leave it open if the repetition is not good enough to resolve the possible coverage issues.

15 – BT plc

We consider coverage enhancements on the UL path are essential for a proper user experience where smartphones should be the main target as they are more limited in space and power. Repetitions and diversity are important factors, but it is required to find ways to reduce the UE power consumption.

16 – Nokia France

Overall, all the coverage enhancement techniques considered under the "coverage enhancement" topic should be applicable for NTN as much as for TN.

For the first three bullets, it is not clear what are the NTN-specific aspects that warrant separate treatment from the terrestrial coverage enhancement topic.

The fourth bullet is too vague: what aspects of RAN protocol overhead might be considered, and what is the relation to low-rate codecs?

The fifth bullet sounds more like a study. Interruption handling techniques already exist, so it is not clear what is missing.

17 – HUAWEI TECHNOLOGIES Co. Ltd.

We suggest to have a short study phase to agree on the deployment scenarios, target service data rate in order to identify the bottleneck channel and performance gap. We suggest to focus on enhancement for uplink. On "improve the performance of low-rate codecs", our analysis is that only the overhead of RLC head can be reduced which does not contribute much for coverage enhancement. We suggest to remove "Investigate means to mitigate packet interruption due to low DL/UL SNR and beam/cell switching for NTN" since it is not quite relevant to coverage enhancement. We suggest the following objectives□

- Study and identify the bottleneck channel and performance gap in NTN considering the target deployment scenarios and service data rate [RAN1]
- Specify if necessary repetitions and diversity techniques for relevant uplink channels [RAN1]

18 – HISPASAT SA

We support this candidate enhancement in Rel-18 and agree with Thale's view.

19 – NEC Telecom MODUS Ltd.

Use cases (enabling commercial smartphones access and VoNR service) are attractive, NEC support this objective in general.

If there is no SI phase, we suggest to keep the objective open to other later identified (if any) necessary enhancements with the overall use case in mind, or a short SI phase might be helpful.

20 – NOVAMINT

We support this candidate enhancement in Rel-18 and share and agree with Thales's view.

21 – Fraunhofer IIS

We agree that coverage enhancement is one important enhancement for Rel18 NTN evolution. We would prefer to distinguish between the enhancements that have been already analyzed as part of Rel17 CovEnh WI and mainly focus on the enhancements taking the characteristics of NTN into account namely, large propagation delay and satellite mobility. Having said this, we propose:

1. Define and specify repetitions and diversity techniques, NTN specific, for the relevant channels beyond techniques proposed in Rel17 CovEnh WI.

Regarding the DMRS configuration enhancement, the objective can be set to reduce the overhead, given the LOS channel in NTN and low mobility UEs (VSAT terminals). We propose the following regarding clarifying the scope of DMRS configuration:

2. Identify and specify the solution to reduce the DM-RS density for NTN scenarios

We are fine with the rest of the objectives identified by the moderator.

22 – Ericsson LM

So far there is no evidence of any specific gaps for NTN. For this reason, we would strongly suggest that any coverage enhancements should be discussed as part of the CE WI.

23 – CEWiT

We support this in Rel-18 NTN enhancement.

24 – Intel Corporation SAS

We are supportive to consider coverage enhancements for NTN in order to make sure that smartphone UE with < 0 dB antenna gain is supported. We have the following comments on the listed objectives.

· For point 1: Study phase is needed in order to identify gaps to support the considered scenario, so we prefer to use wording "Study and specify, if needed" instead of "Define and specify".

· For point 2: CSI aging issue was considered during the Rel-16 NTN SI. Based on this study we are not convinced that specification enhancements are required in order to handle CSI aging issue. If needed, implementation-based techniques (i.e. without spec change) to reduce impact of CSI aging can be considered.

· For point 3: The wording can be misleading with two different interpretations: (1) select DMRS configuration from the already supported configurations, (2) specify new DMRS config (pattern, number of symbols, symbol position, etc.). This point should be clarified. If the intention is to specify new DMRS configuration then study phase is needed.

· For point 4: It's mainly for voice service, and a study phase is needed to evaluate how much gain we could get by reducing protocol overhead. Then decision can be made based on the evaluation result.

· For point 5: It's not really relevant to coverage enhancement. It's more like how to handle radio link failure and recovery effectively (to mitigate packet interruption due to low DL/UL SNR), and adaptation of DAPS handover in NTN (cell switching case). It would be better to further clarify the detail.

25 – Apple AB

These objectives look good on the whole. The last objective appears to be quite broad and somewhat unclear. Is the intent to develop faster mechanisms for handover and re-establishment? If so, the last objective can be rephrased suitably.

We are also not sure the relationship between relevant CSI aging mitigation and coverage enhancement. Some clarification is needed.

We share Thales's view on adding a new objective: "Evaluate the coverage performance and identify the candidate channels that have coverage issues [RAN1]". This objective should be fulfilled before the other objectives.

26 – InterDigital

We support this in Release 18, however we share the view that the focus should be on identifying NTN-specific aspects (e.g. propagation delay) which would impact adoption of existing CovEnh solutions defined for TN.

27 – MediaTek Inc.

The scope of coverage enhancements seems too wide. Some prioritization would be helpful:

1. Low-rate codecs in link budget limited situation including reducing RAN protocol overhead for VoNR
2. RACH enhancements - .e. repetitions, diversity techniques, …

Mitigate packet transmissions on beam edge can be addressed in mobility enhancements

28 – Gatehouse Satcom A/S

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

29 – HUGHES Network Systems Ltd

We support this candidate enhancement in Rel-18. The objectives look good on the whole and also agree with Thales to add "Evaluate the coverage performance and identify the candidate channels that have coverage issues [RAN1]"

30 – Sony Europe B.V.

Agree with Rakuten on additional objective:

· Interference management between TN and NTN and between NTNs of differing orbits. [RAN1]

Are the brackets in the following objective in the right place?

Define and specify repetitions and diversity techniques for the relevant channels (including PRACH and techniques to enable full-power UL transmission and reduced polarization loss) [RAN1]

Presumably, this should read:

Define and specify repetitions and diversity techniques for the relevant channels (including PRACH) and techniques to enable full-power UL transmission and reduced polarization loss [RAN1]

31 – Classon Consulting

for FUTUREWEI If included, should be a study first where existing coverage improving techniques from R15-17 are part of the baseline.

32 – Qualcomm Incorporated

We agree to the above objectives. Further, we need to explicitly state that the objectives cover the important use case of regular smart phones with more realistic assumptions on antenna gains, e.g., -5dBi instead of 0dBi typically assumed for link budget analysis for terrestrial networks.

1.1.1.2 NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE

Some of this work is already confirmed to start in RAN4 after March 2022 considering Ka band as candidate example band once FR1 NTN coexistence study is stable enough per RAN#92-e agreement in RP-211596. The moderator recommendation is to focus the initial work on the general issues of NTN operation with TDD bands and FDD in FR2 and the handling of 7-24GHz bands and to consider the following as the list of possible objectives as a starting point.

- Study and identify NTN bands: Analysis of regulations and adjacent channel co-existence and future-proof protection of TN [RAN4]
    - Consider Ka band as the example band [RAN4]
- Specify Rx/Tx requirements for different VSAT/ESIM UE class (not only 60 cm aperture) [RAN4]
- Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed [RAN4]
- Specify the RRM requirements [RAN4]
- Specify the conformance testing [RAN4]
- Specify physical layer parameters such as SCS for SSB, data channels [RAN1,RAN4]
- [Specify beam management and BWP operation/switching in NTN considering the characteristics of satellite beams (e.g., large beam foot print, multiple beams per satellite, and FDD for FR2)] [RAN4]

Feedback Form 2: NR-NTN deployment in above 10 GHz bands

1 – THALES

We support this candidate enhancement in Rel-18.

We agree in general with this set of objectives however

1/ we propose that the following assumptions be added:

- *GEO and NGSO (e.g. LEO, MEO, HEO) based satellite access to be considered*
- *Targeted UE types: fixed and mobile VSAT. VSAT/ESIM UE characteristics from TR38.821 to be considered in priority but additional NTN UE classes may be considered*
- *FDD mode is assumed for satellite operation above 10 GHz;*
- *TDD mode is assumed for terrestrial operation in FR2.*
- *The harmonized Ka band frequency range (17.7-20.2 and 27.5-30.0) as common across all regions will serve as reference;*

2/ With respect to the following objective

- *Study and identify NTN bands: Analysis of regulations and adjacent channel co-existence and future-proof protection of TN [RAN4]*
  - *Consider Ka band as the example band [RAN4]*

We suggest to modify it as follow for clarification:

- *Study and identify NTN bands: Analysis of regulations and of relevant adjacent channel co-existence scenarios [RAN4]*
  - *Consider Ka band as the example band [RAN4] ;*
  - *Satellite bands introduced in 3GPP for NTN for FDD shall not impact the existing 3GPP TDD specifications for terrestrial bands (see note 3 of the approved way forward RP-211596 in RAN#92-e)*
  - *Relevant coexistence scenarios and analysis to be considered in RAN4, if and where applicable*
  - *Definition of NTN band(s) above 10 GHz does not change the current FR1/FR2 definition, nor automatically apply to future terrestrial bands defined in this frequency region; (see proposal 3 of the approved way forward RP-211596 in RAN#92-e)*

3/ Leading WG = RAN4, Secondary WG = -

4/ Potential interaction with SA/CT: None

2 – Intelsat

We support this enhancement in Rel-18, we believe this is a very important aspect for NTN.

While we support the consideration of Ka band as an exemplary band, we wish to stress that other bands should not be excluded such as Ku, Q, and V bands, even if not considered as an exemplary band.

We believe the issue of co-existence studies can be resolved in RAN 4 similar to how is has been done in the past for other NR aspects such as NR-U. It is not clear why further limiting the scope of any study in this context is necessary.

We further would like to emphasize the importance of Rx/Tx the VSAT/ESIM UE class characteristics.

3 – Eutelsat S.A.

Agree with Thales. Further clarification is needed on what is to be requested from RAN4 (and why).

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are generally fine with the objectives.

5 – Samsung Electronics Co.

We are fine with Moderator's proposals for this topic.

6 – Guangdong OPPO Mobile Telecom.

we support moderator's proposal.

7 – Spreadtrum Communications

We agree that NR-NTN deployment in above 10 GHz bands can be considered in R18.

8 – Panasonic Corporation

We support this in Rel-18 and Thales proposal. We also support Intelsat comment "other bands should not be excluded such as Ku, Q, and V bands".

However, there are no PRACH configuration index specified for FR2FDD in 38.211 on above 10GHz. To specify it for above 10GHz FDD would be necessary.

9 – ESA

We support this candidate enhancement in Rel-18, and already endorsed in RAN#92e. We are fine with Thales' view.

10 – CATT

We support this enhancement in Rel-18, and agree with the modified objectives provided by Thales.

11 – CATT

We support to further work on the TN-NTN coordination.

About the service continuity, we assume RAN3 should also be involved in for the interface work, e.g.

- The enhancement to Xn/NG to exchange the necessary information between TN and NTN gNBs, e.g. RAT type of each serving cell.

For Dual Connectivity & Carrier Aggregation, we understand it's not so urgent in Rel-18, we should focus on basic mobility case and necessary enhancement on handover.

12 – China Mobile Group Device Co.

Support the provided enhancements.

13 – ZTE Corporation

It's mainly RAN4 works and prefer to take it along with the RAN4 package.

14 – Beijing Xiaomi Mobile Software

We generally support Thales' update.

15 – HUAWEI TECHNOLOGIES Co. Ltd.

We support to include NR-NTN deployment in above 10 GHz bands in Rel-18 and suggest the following objectives:

- Specify the following physical layer aspects: time relationship related enhancement (K_offset), subcarrier spacing for different UL/DL signals/channels, PRACH configuration for FDD in above 10 GHz band [RAN1, RAN4]

- Study and identify NTN bands considering Ka band as the example band including [RAN4]
  - Analysis of regulations in the spectrum considered
  - Adjacent channel co-existence
- Specify RF Rx/Tx core requirements for satellite node and different VSAT class [RAN4]
- Specify the RRM requirements [RAN4]
- Investigate and, if needed, specify UE timing & frequency pre compensation accuracy requirements [RAN4]

16 – HISPASAT SA

We support this candidate enhancement and agree with Thales' objective proposal.

17 – Nokia France

The importance of FR2 support for NTN is fully understood, but, given the current and expected future workload of RAN4, proponents of FR2 support for NTN are strongly encouraged to limit the scope and objectives to the absolute minimum, and make it clear that only NTN deployments are addressed, not TN.

Given that there are currently no requirements in RAN4 for FDD above 10GHz, nor any resolution for how to introduce NR bands in the 7-24GHz range, substantial TUs would have to be allocated in RAN4 for this work.

For RAN1-impacting aspects, maximum reuse of existing L1 parameters and design should be made, e.g. especially with respect to SCSs.

18 – NOVAMINT

We support this candidate enhancement in Rel-18 and share and agree with Thales's view.

19 – Fraunhofer IIS

We support Thales' views on this topic.

20 – Ericsson LM

We would propose the following changes for RAN4: a) Add the following objectives: 1) co-existence study to ensure there is no interference of NTN toward TN; 2) study implications of FDD operation in FR2 and derive requirements appropriately; 3) clarify how to define requirements on the Ka band in the 7-24 GHz range, including the relation to existing FR1/FR2 (and perform the necessary coexistence studies); 4) [under RRM] identify and specify impacts to beam management requirements for VSAT UE class; b) Change "consider Ka band as the example band" to "Consider part or all of the Ka band as the example band, according to ITU allocation; identify which parts of the Ka band are suitable as 3GPP bands".

21 – Intel Corporation SAS

For "Specify physical layer parameters such as SCS for SSB, data channels [RAN1, RAN4]"

o It is not clear if RAN1 input is really needed – if RAN1 input is required it can be handled via LS. Also, it shall be clarified that introduction of new SCS values is not in scope, the following sub-bullet can be added "Introduction of new SCS value on top of the already supported values is not considered".

For "[Specify beam management and BWP operation/switching in NTN considering the characteristics of satellite beams (e.g., large beam foot print, multiple beams per satellite, and FDD for FR2)] [RAN4]"

o It is confusing that this objective is handled by RAN4 since according to the wording new feature for physical layer is considered which is handled by RAN1. Clarification is needed on the intention for this point. If the intention is specification of physical layer features/enhancements, then it is appreciated if proponents can propose more detailed description of the corresponding features/enhancements which are considered.

NTN work in Rel-18 may have a potentially large scope in RAN4 including NR-NTN deployment in above 10 GHz and requirements for new Rel-18 features. Further prioritization of work can be required taking into account available RAN4 TU capacity.

22 – InterDigital

We are in general supportive of Moderator's proposal.

23 – Gatehouse Satcom A/S

We support this candidate enhancement in Rel-18 and agree with Thales's view.

24 – HUGHES Network Systems Ltd

We support this candidate enhancement in Rel-18 and as per endorsed and captured in RP-211596. In general we agree with the set of objective provided by the moderator. We propose the following assumptions:

- GEO and NGSO (e.g. LEO, MEO, HEO) based satellite access to be considered
- Targeted UE types: fixed and mobile VSAT. VSAT/ESIM UE characteristics from TR38.821 to be considered in priority but additional NTN UE classes may be considered
- FDD mode is assumed for satellite operation above 10 GHz;
- The harmonized Ka band frequency range (17.7-20.2 and 27.5-30.0) as common across all regions will serve as reference

With regards to the objectives, we proposed some adjustments (based on RP-211596)

- Study and identify NTN bands: Analysis of regulations and of relevant adjacent channel co-existence scenarios [RAN4], with the following notes:

Consider Ka band as the example band [RAN4] ;

Satellite bands introduced in 3GPP for NTN for FDD shall not impact the existing 3GPP TDD specifications for terrestrial bands (see note 3 of the approved way forward RP-211596 in RAN#92-e)

Relevant coexistence scenarios and analysis to be considered in RAN4, if and where applicable

Definition of NTN band(s) above 10 GHz does not change the current FR1/FR2 definition, nor automatically apply to future terrestrial bands defined in this frequency region; (see proposal 3 of the approved way forward RP-211596 in RAN#92-e)

25 – Classon Consulting

for FUTUREWEI Some aspects could be direct work objectives, some study and then specify. Mostly RAN4, some RAN1.

26 – MediaTek Inc.

Generally supportive of moderator proposal

27 – Qualcomm Incorporated

We are fine with the proposed list of objectives. However, we believe we should consider FDD bands only before the support of TDD for NTN is studied in RAN1.

1.1.1.3 NTN-TN and NTN-NTN mobility and service continuity enhancements

The moderator recommendation is to consider existing methods from NR TN as baseline for NTN-TN mobility as well as Rel-17 WI outcome and further mobility enhancements for NTN-NTN can be considered if new issues are identified in Rel-18. Based on the outcome, the following list would be used as a starting point and further refined based on the gaps for NTN-TN and NTN-NTN. More detail needs to be added for any items listed as enhancements. Please add your views with specific actionable objectives for any items listed as enhancements.

- Address handover interruption, handover signalling overhead and RACH congestion [RAN2]
- Address RLF reduction issue for different delay and/or network topology between the different access types/points/nodes [RAN1, RAN2]
- Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements [RAN1,RAN2,RAN4]
    - [Evaluation of multi-connectivity for NTN as one possible service continuity enhancement] [RAN1, RAN2]

Feedback Form 3: NTN-TN and NTN-NTN mobility and service continuity enhancements

1 – Rakuten Mobile

RACH congestion will be crucial issue to resolve in NTN due to limited of UE density support . We also support MRDC & ENDC Support for NTN along with TN as part of Mobility & service continuity enhancements.

2 – THALES

We support this candidate enhancement in Rel-18.

We agree with the following objectives

· *Address handover interruption, handover signalling overhead and RACH congestion [RAN2]*

· *Address RLF reduction issue for different delay and/or network topology between the different access types/points/nodes [RAN1, RAN2]*

· *Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements [RAN1,RAN2,RAN4-RD (RRM)]*

We propose one additional objective:

· *Specify the support of enhanced schemes such as the DAPS to guarantee the service continuity [RAN2]*

Last we are open to address as part of this topic the following objective but the details should be refined considering Feedback Form 5: NTN-NTN asynchronous multiConnectivity & Carrier Aggregation

· *Evaluation of multi-connectivity for NTN as one possible service continuity enhancement [RAN1, RAN2]*

Leading WG = RAN2, Secondary WG = RAN1, RAN4-RD (RRM)

Potential interaction with SA/CT: None

3 – Intelsat

We agree with the objectives outlined by Thales.

4 – Eutelsat S.A.

Agree with Thales.

5 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

The NTN-NTN mobility enhancements including new CHO conditions developed in Rel-17 NR NTN can be considered as baselines. The Rel-18 NTN objectives shall focus on the applicability of these enhancements NTN-TN scenario, and identify potential issues and enhancements for service continuity if necessary. RAN2 shall be the leading WG for these objectives.

- For the third bullet (Specify NTN-TN and NTN-NTN measurement/mobility…), suggest to address "for different delay and/or network topology between the different access types/points/nodes" as in the second bullet to focus efforts.

- For the multi-connectivity part list, some possible issues or existing solutions that may be applied with minor enhancements, e.g. MCG/SCG failure recovery, support of DAPS. [RAN2] And we also prefer to consider the spec impact of CA/DC in NTN in the context of multi-connectivity.

6 – vivo Mobile Communication Co.

We agree with studying and/or specifying enhancements for NTN-TN mobility and for NTN-NTN mobility. Since the globally seamless and ubiquitous access by an integrated TN-NTN coverage is expected as the mainstream for future wireless network evolution, the seamless switching between them with guaranteed performance is important. Two more comments as follows:

- For support of multi-connectivity, we would like to also add "TN-NTN" DC in the scope. A typical use case would be that the UE with the MN connected to NTN which reduces the frequency of handover due to potentially broad coverage of NTN, and with SN connected to TN which provides high-speed service transmission. As anyway the multi-connectivity needs to be evaluated first (instead of being directly specified), there is no harm to consider one more scenario.

- Also, for above 1st bullet, RACH related discussion may be relevant to RAN1 per Rel-17 experience. So RAN1 could be added as the secondary responsible WG for that objective.

7 – Samsung Electronics Co.

We support this issue/objectives to be handled in Rel-18.

8 – Guangdong OPPO Mobile Telecom.

we support moderator's proposal and also agree with Thales proposed added objectives.

9 – Spreadtrum Communications

We think the following objectives can be prioritized:

- Address handover interruption and handover signalling overhead ~~and RACH congestion~~ [RAN2]
- Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements [RAN1,RAN2,RAN4]

10 – ESA

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

11 – CATT

We support to further work on the TN-NTN coordination.

About the service continuity, we assume RAN3 should also be involved in for the interface work, e.g.

- The enhancement to Xn/NG to exchange the necessary information between TN and NTN gNBs, e.g. RAT type of each serving cell.

For Dual Connectivity & Carrier Aggregation, we understand it's not so urgent in Rel-18, we should focus on basic mobility case and necessary enhancement on handover.

12 – China Mobile Group Device Co.

Agree to discuss the objectives suggested by the moderator in R18.

13 – ZTE Corporation

- We support study of the enhancements to reduce handover interruption time and the signaling overhead and to address the potential RACH congestion.
- Regarding the RLF reduction, we do not see a clear need for any enhancements and would prefer to rely on the existing procedures.
- On NTN-TN and NTN-NTN measurement/mobility and service continuity, we understand that there has been some progress made in R17 with more SMTC introduced for measurements, new CHO trigger introduced for connected mode mobility, and ongoing discussion on the idle mode mobility. In Rel-18, we can focus on the applicability of the R17 mechanisms and identify potential issues if there are any. In addition, we have not had enough time to discuss the PCI collision issue in NTN-TN mobility in R17, we would like to have it as part of R18. On multi-connectivity for NTN, we are concerned about the workload as the discussion for CA/DC always take a lot of time and the gain of having it in NTN is not clear to us.

14 – DOCOMO Communications Lab.

We support this topic for seamless service. Rel-18 should include this topic.

15 – Beijing Xiaomi Mobile Software

We are supportive to the objectives listed by the moderator. For the third bullet, beside multi-connectivity for NTN, the DAPS and TN-NTN DC also can be considered.

16 – BT plc

It is important to enhance mobility but it is also important to enhance cell reselection mainly for NTN to TN. We don't want UEs performing TN neighbour cell measurements for reselection when they are not even in TN coverage. RACH congestion needs to be enhanced to ensure a high volume of devices are capable to perform RACH mainly in LEO semi-static beams where most of connected users may execute the handover simultaneously. It is important to minimize control signalling after the RACH.

17 – HISPASAT SA

We support this candidate enhancement in Rel-18 and share Thales' views.

18 – NEC Telecom MODUS Ltd.

NEC support to further work on mobility and service continuity enhancement following Rel-17 work.

Bullet #1 and #3 are more fundamental aspects and should be prioritized. In case we need to limit the scope, we would like to deprioritize bullet #2 and especially bullet#4: multiple connectivity between NTN cells does not seems possible for most of UEs considering the big cell size of NTN; Multiple connectivity between NTN-TN is only possible if there is TN coverage, which is also less common, and CHO/DAPC could be considered first.

19 – HUAWEI TECHNOLOGIES Co. Ltd.

The candidate proposals are very vague and it is not clear what issues the proposed enhancements are trying to solve.

For handover interruption, handover signalling overhead and RACH congestion, it was discussed in Rel-17 but postponed. To re-open these topics, the motivation and potential benefit should be clarified taking Rel-17 work into account. For example, for handover interruption, CHO can reduce the transmission interruption due to early data forwarding between source cell and target cell. It is not clear how much additional benefit can be achieved with the proposed enhancements. It would also be helpful to understand the detailed traffic or service requirements and how sensitive they are for handover interruptions in NTN.

For RLF reduction issue for different delay and/or network topology between the different access types/-points/nodes, in R17, several CHO mechanisms are introduced which can reduce potential RLF during the mobility. We would suggest proponent to clarify the use case first.

For NTN-TN and NTN-NTN mobility and service continuity enhancements, we suggest to clarify the deployment scenario and potential issues before proceeding with the detailed enhancement.

20 – Nokia France

Generally we support these objectives, with some clarifications:

For "address handover interruption", it should be clarified what is not already covered by CHO.

"RLF reduction issue" also needs clarification.

21 – NOVAMINT

We support this candidate enhancement in Rel-18 and agree with Thales's view and proposed added objectives.

22 – Fraunhofer IIS

We support this candidate enhancement in Rel-18.

23 – Ericsson LM

We agree to study these aspects with the exception of multi-connectivity. Multi-connectivity seems premature at this time and should be discussed for potential study in future releases.

24 – CEWiT

We support to further work on the TN-NTN coordination. NR mobility frame work can be baseline. We are fine to enhance the NTN-NTN mobility and service continuity support.

25 – Intel Corporation SAS

Not clear if RAN1 input is required for points 2 and 3. RAN2 WG should be primary WG for the objective.

For point 1: regarding handover interruption, it seems more or less a overlap with "Investigate means to mitigate packet interruption due to low DL/UL SNR and beam/cell switching for NTN [RAN2, RAN1]". As for handover signalling overhead and RACH congestion, it would be good to clarify the use case, e.g., in earth-moving case when multiple UEs handover simultaneously along the satellite slides over earth surface.

For point 2: it's not clear what is the RLF reduction issue, as it has not been discussed in R16 NTN SI and R17 WI. This concept needs to be clarified first.

For point 3: the bullet description can be more concise if the purpose is to support NTN-NTN DC and NTN-TN DC.

26 – Apple AB

27 – InterDigital

We support Moderator's proposal. We would further suggest that discontinuous coverage scenario may also be considered in service continuity enhancements and may take solutions developed in Rel-17 IoT NTN as baseline.

28 – MediaTek Inc.

We are generally supportive of this topic.

NTN-NTN should be prioritized in Rel-18.

For TN-NTN it is sufficient to have basic service continuity

29 – Gatehouse Satcom A/S

We support this candidate enhancement in Rel-18 and agree with Thales's view.

30 – Sony Europe B.V.

When beams/cells move, a large number of UEs may have to be handed over together. Hence, we suggest an additional objective:

- Address group handover configuration and procedure (enhancements?) [RAN2]

Some territories may not license NTN services. UEs in such territories should be refused service based on their location depending on the progress in Rel-17. Hence, we suggest an additional objective:

o UE location-based refusal of service [RAN2, RAN3]

The objectives should be talking about "PRACH congestion" rather than "RACH congestion"

31 – HUGHES Network Systems Ltd

We support this candidate enhancement in Rel-18. We support Thales' view.

32 – Classon Consulting

for FUTUREWEI If included after clarification, should be a study first.

33 – Qualcomm Incorporated

We are fine with the first two bullets. For the third bullet: We do not think multi-connectivity should be studied as part of service continuity enhancement. Whether to specify multi-connectivity for NTN is a separate discussion on itself, as discussed in feedback form 5 below.

1.1.1.4 Network based UE location

The moderator recommends starting the Rel-18 work with a study item to determine how the network can determine the UE location without relying on UE GNSS measurements or support. Further discussions are required to identify the priority level, clarify the scope and to consider leveraging existing positioning solutions. Further discussion needs to occur at RAN#94-e concerning the priority level and handling of the work in Rel-18 and if it should be treated in the Evolution of NR NTN area or in the Positioning Enhancements area to involve positioning experts.

Interested companies are encouraged to provide a list of objectives for the possible study item in the first round with impacted WGs identified for each objective.

Feedback Form 4: Network based UE location

1 – THALES

We support this candidate enhancement in Rel-18.

We propose that the following set of objectives:

· *Evaluate the existing positioning methods applicable to UE connected via an NTN network [RAN1]*

· *Identify and specify any enhancements necessary to support LCS in NTN networks using existing methods, or if necessary specify a new positioning method applicable to NTN network [RAN1]*

· *Enhancements may include additional measurement information to be reported by the UE to the LMF, additional information provided by the gNB to the LMF. Periodicity and accuracy of these information will have to be discussed [RAN1]*

· *Identify the performance achievable in NTN network (i.e. accuracy of the UE location) [RAN1]*

· *Signalling overhead and efficiency impact [RAN2]*

· *Signalling between gNB and LMF (e.g. reporting of satellite ephemeris to LMF) [RAN3]*

Leading WG = RAN1, Secondary WG = RAN2, RAN3

Potential interaction with SA/CT: SA2, SA3 and SA3-LI with respect to 'Network verified UE location' and 'UE independence of GNSS' and their possible impact on regulatory requirements (e.g. LI, PWS,…)

2 – Intelsat

We support the views shared by Thales.

3 – Eutelsat S.A.

Agree with Thales. Also this work (or some aspects) could be applicable to IoT-NTN.

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

If treated in Rel-18 NTN area, objectives shall initially focus on the applicability of existing positioning solutions to NTN, and identify potential issues and enhancements if necessary, considering the NTN characteristics including large propagation delay and satellite movement. The corresponding RS design and measurement reporting can be studied. The objective may include:

- Identify possible architectural enhancements for NTN positioning network [RAN3, RAN2]
- Identify possible issues of applying existing network-based positioning solutions in NTN, and specify enhancements (RS design, measurement reporting, etc.) if any. [RAN1. RAN2, RAN3]
- Study possible enhancements to support existing RAN-independent/RAN-dependent positioning methods in NTN [RAN1, RAN2]
- Study and evaluate new positioning methodologies for NTN supported scenarios, (if needed) [RAN1, RAN2]

5 – Samsung Electronics Co.

We are open to discuss but prefer to take it as the 2nd priority.

6 – Guangdong OPPO Mobile Telecom.

we support to study the potential enhancement in this direction.

7 – Spreadtrum Communications

We are open to this topic. We agree to moderator's recommendation that a study item is needed to identify the priority level, clarify the scope and to consider leveraging existing positioning solutions. This topic should be treated in the Evolution of NR NTN area.

8 – ESA

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

9 – DOCOMO Communications Lab.

Rel-17 NR positioning has specified some enhancements. Hence, applicability of those NR solutions to NTN should be considered first. In addition, we think positioning SI/WI would be better to discuss this feature. For example, SL positioning is discussed not in SL SI/WI but in positioning SI/WI.

10 – CATT

We support this candidate enhancement in Rel-18, and share the view with Thales on the objectives.

11 – China Mobile Group Device Co.

Support. UE location acquisition solutions for NTN scenarios are demanded to study. And the existing LCS solutions could be the baseline.

12 – ZTE Corporation

Regarding this topic, we prefer to deprioritize the study in Rel-18, at least as the 2nd priority. From our perspective, we need to first understand the potential requirement to enable such functionality due to the needs of regulation, which may be up to the inputs from SA. Otherwise, it will be weird to conclude whether enhancement is needed or not.

13 – Beijing Xiaomi Mobile Software

We support to have this topic in Rel-18:

- Study the feasibility of Rel-16 RAT dependent positioning for NTN and specify the necessary enhancements to support positioning for NTN including [RAN1 RAN2]:
  - Positioning with single/multiple satellite(s)
  - Multi-RTT/RSTD with single node in different time
- Identify positioning architectural enhancements for NTN network based positioning [RAN2 RAN3]

14 – CATT

On top of the objectives, we would propose to add another objective:

- Study the UE positioning in RRC-IDLE mode to make it possible for a non-GNSS capable UE access to the network.

15 – HISPASAT SA

We support the enhancement of current LCS mechanisms to ensure UE location can be effectively prrocessed from network, both for regulatory requirements, UE whithout GNSS or for coverage enhancement in areas with bad non-network location mechanisms or indoor.

16 – HUAWEI TECHNOLOGIES Co. Ltd.

According to our understanding, this potential objective is included because SA3LI notes that any method which relies solely on UE-generated location information is unlikely to be considered reliable for network selection purposes. Therefore, a method such as GNSS/A-GNSS cannot be considered as reliable or trusted **unless the information provided by the UE can be verified by the network**. We therefore would like first to confirm that the potential study/work is to support **verification of UE reported location instead of to support UEs without GNSS capability at all.** Secondly, we would like to understand the positioning accuracy requirement better, i.e. what is the maximum positioning tolerance under which the network can verify that the information provided by the UE is reliable or trusted. If the intention and positioning accuracy can be further clarified, we suggest to start with a study item focusing on study and evaluate solutions for network to **verify** UE reported location information.

17 – Nokia France

Network-based UE location is important for scenarios when the link budget supports NTN operation but not GNSS. The objective should be:

- Specify measurements and protocols to support network-based RAT-dependent positioning for NTN [RAN1, RAN2, RAN4]

18 – NOVAMINT

We support this candidate enhancement in Rel-18 and agree with Thales's view and objectives.

19 – Fraunhofer IIS

We are generally supportive of this feature for Rel18 NTN evolution. We support Thales views on this issue and have the following objective goal:

- We should define what is necessary to support 'Network verified UE location' during initial access and connection setup, i.e. before completion of the setup of the LCS framework

20 – Ericsson LM

In our view, network-based UE location aspects should be handled in the Positioning WI (also for very practical reasons: discussing positioning aspects in the NTN sessions would require additional planning by the WG leaders to avoid conflicts for the positioning experts). Furthermore, all regulatory requirements (lawful intercept, emergency calls, etc.) can be met already with the Rel-17 solutions (with the same requirements as in terrestrial networks). In any case, we strongly advise against adding a study phase in in a WI, as that has a tendency to prevent a "clean" discussion, pre-empting the study outcome.

21 – CEWiT

We support this candidate enhancement in Rel-18. Further support in RRC-IDLE mode objective should be added in the scope.

22 – Intel Corporation SAS

We suggest to include the following objective for the network-based positioning.

· Study network-based positioning solutions suitable for NTN considering security and regulation requirements.

Our preference is to consider the NTN network-based positioning under Positioning Enhancements WI/SI.

23 – InterDigital

We support network-based UE location and share the view that Rel-18 work should start with a study item. We think the objectives proposed by Thales would be a good starting point.

24 – Gatehouse Satcom A/S

We support this enhancement, and generally fine with Thales' view, and are supportive to the view of Huawei in relation to focus on the verification of the location reported by the UE as priority.

25 – MediaTek Inc.

Requirements for network-based UE location could be as in Rel-17 NTN. To reduce specification impact, legacy physical design with minimum adjustment / configuration enhancements should be baseline.

26 – Sony Europe B.V.

Given the amount of work that would be entailed in defining an NTN-based positioning solution, the existence of other satellite-based positioning solutions (i.e. GNSS) and the limited number of TUs, we do not think that NTN-based positioning is a priority for Release-18.

27 – HUGHES Network Systems Ltd

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We support this candidate enhancement in Rel-18. We are fine with
   Thales' view.
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28 – Classon Consulting

for FUTUREWEI Low priority, and if study to be done it should be in positioning and not here.

29 – Qualcomm Incorporated

We suggest the following study item: UE positioning techniques with the assumption that the number of satellites in view is limited (including single satellite).

This assumption is realistic at least for the initial deployment of the NTN systems, where the total number of satellites will be limited. The assumption may make some of the existing positioning solutions from terrestrial networks unusable. Additionally, the first objective of network-based UE location shall target first necessary regulatory requirements and requirements for communication (with an accuracy that may be km-level), without precluding reusing the same techniques in other scenarios that may lead to higher accuracy positioning.

1.1.1.5 Other comments for controversial topics identified in RP-211658

This section will focus on driving to consensus on previously identified controversial topics in RP-211658 if compromise can be achieved. There is no need to repeat positions expressed in the RAN93e Rel-18 Prep discussion.

Proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18 Prep discussion when presenting possible solutions. There is a feedback form for each controversial topic for companies to add any proposals for compromise and/or way forward on a set of objectives for each topic that might be agreeable.

Feedback Form 5: NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation

1 – Rakuten Mobile

NTN Multi-connectivity & carrier aggregation shall improve user throughput & connection reliability.

2 – THALES

We support this candidate enhancement in Rel-18.

We propose that the following set of objectives (assuming leveraging existing Multi/Dual connectivity feature):

- *Address different delay and/or network topology between the different access points/satellite nodes.*

[RAN1, RAN2]

- *Handling different time and frequency compensation [RAN1]*
- *Master node versus secondary node selection [RAN3]*

We also propose that the following set of objectives (assuming leveraging existing Carrier Aggregation features):

- *Specify RF and RRM core requirements for the upgrade band combination capabilities for NTN [RAN4]*

Leading WG = RAN1, Secondary WG = RAN2, RAN3, RAN4

Potential interaction with SA/CT: None

3 – Intelsat

We support the views shared by Thales.

Of particular importance is the consideration for timing and frequency compensation.

4 – Eutelsat S.A.

Agree with Thales.

5 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

Asynchronous multi-Connectivity & Carrier Aggregation & Carrier Aggregation can be useful for optimizing performance (mobility, service continuity and throughput) of NTN. Enhancements for NTN-NTN application may include:

- Identify possible issues in MCG/SCG failure detection and recovery, considering the NTN characteristics including large propagation delay and satellite movement. [RAN2]

6 – vivo Mobile Communication Co.

For NTN-NTN asynchronous multi-Connectivity, we would like to include TN-NTN DC in this objective additionally, in which case TN can provide coverage and TN can assist to increase throughput.

For NTN-NTN asynchronous CA (if supported), we would like to prioritize the intra-gNB CA on the same satellite.

7 – Samsung Electronics Co.

We support this topic in Rel-18. We think this feature can enhance the mobility in NTN scenarios and share the similar views on the objectives.

8 – Guangdong OPPO Mobile Telecom.

we are fine to support multi-connectivity and CA in R18.

9 – ESA

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

10 – Spreadtrum Communications

We are fine to discuss multi-connectivity & carrier aggregation in R18 NR NTN.

11 – CATT

We would like to clarify what's the scenarios and use cases to support this, for both LEO cells, or LEO +GEO, TN + NTN?

12 – ZTE Corporation

Regarding the asynchronous CA/DC part, from a deployment perspective, it's premature to trigger the study due to limits on the satellite constellation in the initial stage of commercialization. Moreover, in the NTN case, based on the evaluation, the limitation of throughput is mainly due to the poor link budget. In this case, the benefits and flexibility to enable CA/DC are questionable. We prefer to postpone it to a later release.

13 – Beijing Xiaomi Mobile Software

We are supportive to include multi-connectivity in Rel-18 NTN enhancements.

14 – BT plc

Carrier aggregation should be the priority. It can be further studied including NTN – TN CA where down-link MBS services can be delivered via NTN leaving other services and UL data traffic via TN.

15 – NEC Telecom MODUS Ltd.

we suggest to delay discussion on multi-connectivity and carrier aggregation, these two features are less important than other identified objectives in our opinion.

16 – HISPASAT SA

We support this enhancement, we are fine with Thales' view.

17 – Nokia France

Considering the overall size of the NTN work, we suggest that this is not needed in Rel-18.

18 – LG Electronics France

We agree that multi connectivity and carrier aggregation should be introduced to support reasonable through in NTN, and we would like to emphasize that the multi connectivity can be also used for service continuity. If connection to one of nodes is lost, other connection can be maintained.

As Vivo commented, we also support TN-NTN multi connectivity.

19 – NOVAMINT

We support this enhancement - we are fine with Thales's view.

20 – Fraunhofer IIS

We support Thales' views on this topic

21 – Ericsson LM

We believe this is premature at this time. This should be treated in the scope of terrestrial networks first.

22 – Intel Corporation SAS

We note the moderator's request for companies to not repeat positions expressed at RAN93e. We will not repeat our views on all of the controversial topics from RAN#93e but would like it to be noted that our views have not changed relative to RP-211658.

23 – Apple AB

24 – InterDigital

We support this enhancement for Rel-18, and think it is an important topic to ensure seamless connection.

25 – Gatehouse Satcom A/S

We support this enhancement, we are fine with Thales' view.

26 – MediaTek Inc.

NTN-NTN asynchronous multi-Connectivity can be addressed in scope of mobility enhancements

De-prioritize Carrier Aggregation as not clear why it is needed, preference to use NR BPW configuration which can support large system bandwidth flexibly

27 – HUGHES Network Systems Ltd

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

28 – Classon Consulting

for FUTUREWEI Low priority

29 – Qualcomm Incorporated

Multi-connectivity & carrier aggregation can be considered in future releases.

Feedback Form 6: Support of MBS

1 – THALES

This is of interest for NTN, but it is unclear what enhancements are needed in NTN context compared to the existing MBS features.

2 – Eutelsat S.A.

We agree with Thales that it is unclear what NTN specific ehnacements are needed.

3 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

MBS can leverage the large coverage of NTN and provide service for a large number of UEs in a specific area with low cost and signalling. Enhancement to the MBS framework can be studied for NTN in Rel-18 considering the NTN characteristics including large propagation delay and satellite movement.

4 – Samsung Electronics Co.

We don't see the strong motivation and what to be enhanced and we think MBS in Rel-17 can be used in NTN.

5 – Guangdong OPPO Mobile Telecom.

The potential enhancements can be further discussed.

6 – ESA

We share the concern expressed by others. It is not clear what is further needed to support NTN by adopting the MBS Rel.17 specifications.

7 – DOCOMO Communications Lab.

We think Rel-17 MBS with Rel-17 NTN can be used without any enhancement. What is the required enhancement should be clarified first.

8 – CATT

The requirement for MBS in NTN is not so clear. Thus, we could low prioritized it in Rel-18, or leave it to the future release.

9 – ZTE Corporation

The potential scope on this topic is not clear and it can be postponed in a later release if any issues based on existing NR MBS are identified.

10 – BT plc

This is a key use case to provide outdoor coverage to emergency service networks, to cover sports event or massive software updates. For NTN, MBS UL signalling can be enhanced to reduce UE power consumption. Potential RACH issues need to be addressed as the number of UEs can grow exponentially compared with TN. It is required to know if there is any restriction on PTP - PTM dynamic switch due to the longer delays compared with TN.

11 – NEC Telecom MODUS Ltd.

MBS over NTN cell is interesting considering its big coverage, on the other hand, NR MBS specification is not mature yet, NEC suggest to delay the discussion till NR MBS specification is clear.

12 – Nokia France

Considering the overall size of the NTN work, we suggest that this is not needed in Rel-18.

13 – NOVAMINT

We share the same view with Thales

14 – Fraunhofer IIS

The scope of the enhancement to support MBS in NTN is not totally clear to us, but we support generally incorporating MBS services in NTN as an important use case, based on the results of the Rel-17 WI on MBS. We are open to discussion with respect to this issue.

15 – Ericsson LM

MBS is currently in progress in Rel-17 for terrestrial networks. What it will look like in terms of architecture is not fully settled yet. Also in this case, it seems premature to discuss it at this time. Furthermore, any potential MBS support by NTN will be highly dependent on the chosen NTN architecture.

16 – Intel Corporation SAS

We note the moderator's request for companies to not repeat positions expressed at RAN93e. We will not repeat our views on all of the controversial topics from RAN#93e but would like it to be noted that our views have not changed relative to RP-211658.

17 – Apple AB

18 – InterDigital

We do not think this necessary in Rel-18.

19 – Gatehouse Satcom A/S

We agree that the enhancement requirements are not clear, and therefore we would like to de-prioritize it for Rel-18.

20 – MediaTek Inc.

Service offering of NTN with MBS and VoNR are key to its success. There seems to be consensus that the effort could small to support MBS, but would need to be clarified. Hence it could be sufficient to have an objective looking at re-using Rel-17 MBS with minimum adaptation to support NTN.

21 – HUGHES Network Systems Ltd

We do not see the strong motivation for this feature in Rel-18.

22 – Classon Consulting

for FUTUREWEI Low priority

23 – Qualcomm Incorporated

We are not sure if there is anything extra needed to support Rel-17 MBS for NTN. But we are open to have a gap analysis if something is missing.

Feedback Form 7: Regenerative Payload with Inter-Satellite Link (ISL)

1 – Rakuten Mobile

We support regenerative Payload with Inter-Satellite Links.

ISL can be utilized for Backhauling as well as sharing UE related information such as doppler and delay.

2 – THALES

We haven't identified any consensus on the architecture scenario to be considered in terms of NG-RAN

functional split between ground/space segment board (e.g. DU, gNB or else on board). We believe it is premature to undertake a normative phase on an architecture scenario that may never be implemented by the space industry. Besides Rel-17 NR-NTN standard doesn't prevent to implement regenerative payloads if needed. More over the need to standardize ISL protocols has not been identified.

3 – Eutelsat S.A.

Similar to Thales view, we don't see regenerative payload as precluded within the Rel-17 standard.

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

Regenerative payload can reduce the network latency and can be studied. RAN3 shall be the leading WG.

- Enhancements on network interface protocols considering limited capacity of ISL. [RAN3]
- Enhancements to solve the feeder link switch issues due to satellite movement. [RAN3]

5 – Samsung Electronics Co.

We support this topic in Rel-18. and we think one of the architectures studied during SI can be chosen.

6 – Guangdong OPPO Mobile Telecom.

support regenerative payload with ISL.

7 – ESA

We support the Thales' view.

8 – China Mobile Group Device Co.

If time allows, we hope to discuss the applicability of all R17 enhancements under the regenerative architecture.

9 – DOCOMO Communications Lab.

We support this topic. Rel-18 NTN should include regenerative payload with ISL since more flexible/robust NTN becomes possible. Current Rel-17 NTN is not sufficient for various deployment scenarios.

10 – CATT

We support Regenerative Payload with ISL in Rel-18.

Consider the work load of Rel-18, we suggest only to focus on the most basic architecture, i.e. full gNB on board a satellite. The other options, e.g. gNB-DU on board, and IAB-like options could be left for future release.

We understand there's no challenges to support this basic regenerative architecture option, the design for transparent payload in Rel-17 could be greatly reused. Support of ISL could be left to transport layer, we only need to focus on the impacts to interfaces over the ISL (e.g. Xn/NG).

Support of Satellite backhauling:

SA1 has approved a Rel-18 proposal in S1-211373, aiming at enabling of additional satellite backhaul scenarios, e.g. gNB connect to 5GC via hybrid backhauling scenarios. SA2 will further work on this in Rel-18.

To satisfy SA1 requirements, we assume the NG-RAN should be involved for, e.g., the Selection of the backhaul(s), traffic switching between the backhauls etc. It's assumed RAN3 or RAN3 + RAN2 will be impacted, detailed RAN impacts on supporting of satellite backhauling scenarios need further study by cooperating with SA2.

The potential objectives:

- Architecture aspects, including the maintenance of the NG interface between satellite gNB and the 5GC. (RAN3)
- User plane enhancement, e.g. adaption of long propagation delay. (RAN2)
- Supporting the ISL may have some impact to SA/CT, e.g. extra-delay over NG interface may need to be considered.
- Support of Satellite backhauling, coordination with SA2 is needed.

To moderator:

Could we add another controversial topic to satisfy SA1 requirements on "support of satellite backhauling" ?

We initially raised this issue in the Rel-18 WS in June, 2021, and this topic is under discussion in SA2 for now, and there're some objectives which have impact to RAN requires RAN input.

11 – ZTE Corporation

It's not preferred to initialize this aspect with consideration of the various architecture. Moreover, from an implementation perspective, not many benefits on the complexity and cost are foreseen compared to the full-gNB on board or transparent payload by introducing other solutions.

Regarding the full-gNB on board and inter-satellite link, since the feeder-link and ISL are mainly up to implementation, and it's not clear on the scope.

12 – SoftBank Corp.

Regenerative payload will definitely be useful for HAPS scenarios. If this scope is included in the WID, it should be explicitly mentioned that HAPS scenarios will be included.

13 – HUAWEI TECHNOLOGIES Co. Ltd.

During the email discussion, it seems that there is some disagreement on the specification impact of Inter-Satellite Link (ISL) in particular on whether the interface between the ISL should be specified. For ISL, our view is that there is no need to specify the lower layer protocols, i.e. transport layer protocol within 3GPP. For regenerative payload, we are supportive to include it in Rel-18. From our view, the main specification impact is in RAN3, and so we suggest to:

- Specify the network architecture, including interface impacts, for the regenerative satellite, e.g. on-board gNB, CU-DU split, including possible down-selection. [RAN3]

14 – HUAWEI TECHNOLOGIES Co. Ltd.

HAPS by its nature belongs to non-terrestrial network. The support of regenerative satellite will benefit HAPS as well. The mobility aspects in HAPS also share some similarities to regenerative satellite. So we suggest to consider the possibility to explicitly include HAPS as an objective in Rel-18 NTN, including updating 38.821 based on the HAPS-specific deployment and configuration.

15 – Nokia France

Considering the overall size of the NTN work, we suggest that this is not needed in Rel-18.

16 – LG Electronics France

We agree with Lenovo that the regenerative payload is needed for reducing signaling delay. We expect the total propagation delay can be reduced to half if ISL is used.

17 – NOVAMINT

We share the same view with Thales.

18 – Fraunhofer IIS

For the efficient support of ISL in satellite communications, a regenerative payload solution is needed. So we support this activity.

19 – Deutsche Telekom AG

Regenerative payload will be useful for HAPS scenarios. In case the regenerative payload is agreed to be included in the WID, HAPS scenarios should be explicitly mentioned.

20 – Ericsson LM

Among the regenerative architectures as documented in TR 38.821, the one with full gNB on board (not precluding ISL) is the most feasible according to the SI conclusions. If we want to pursue regenerative architecture in Rel-18, that should be our architecture of choice. If no consensus for the Rel-18 WI, we should continue with the transparent architecture.

21 – Intel Corporation SAS

We are open to consider regenerative Payload with Inter-Satellite Link with study item phase to select one architecture for regenerative payload from TR 38.821 and identify enhancements to support it.

22 – Apple AB

23 – InterDigital

We agree with the view of Thales and others that it may be premature to start a normative phase considering there is no consensus on the architecture scenario. We think the specification impact is not trivial, and there is already much to do in NTN.

24 – Gatehouse Satcom A/S

We support the Thales' view.

25 – Sony Europe B.V.

· Timing relationship enhancements for regenerative payloads will be different from transparent payloads

· Logical interfaces on ISL have to be specified but not necessarily the physical interfaces

26 – Omnispace

We support regenerative payload with ISL to enable more efficient and flexible NTN deployments. The current Rel-17 NTN is not sufficient for all deployment scenarios.

27 – HUGHES Network Systems Ltd

We support regenerative payload but do not believe it is needed in Rel-18. Agree with Thales that there has been no consensus on the architecture scenario to be considered.

28 – Classon Consulting

for FUTUREWEI High priority, with study phase to select architecture

29 – MediaTek Inc.

This seems much needed to avoid packet interruption in case not possible to have Gateways in vast oceans or deserts for LEO. It is not clear whether this can be up to implementation, or needs to be specified. At a minimum, signalling enhancements for the longer satellite RTT delays could be discussed due to multi-hop transmission could be considered.

30 – Qualcomm Incorporated

We think regenerative payload should be higher priority than ISL, but we do not see any of the two items as critical.

Feedback Form 8: Enhanced beam management

1 – THALES

Beam determination techniques would eventually rely on traffic historical data and satellite ephemerides. However, it would be relevant to understand if the legacy beam procedures can already support this for certain NTN scenarios and therefore the scope of the work to be carried out would require further discussion.

2 – Intelsat

We believe a study may be able to clarify the extent of this issue for NTN relative to the existing solutions in NR Rel-17.

3 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine to study some possible leftovers, e.g. association between beam and BWP for FRF>1, BFR enhancement for FRF>1 in beam management to address the large signaling overhead problem from Rel-17

NTN. RAN1 shall be the leading WG. Polarization related leftover issues such as polarization multiplexing and UL polarization enhancements may also be addressed.

4 – Samsung Electronics Co.

We are open to discuss, but it is unclear what to be enhanced in NTN scenarios.

5 – Guangdong OPPO Mobile Telecom.

We support to discuss the enhancement for beam management. In R18, some issues have been identified. While the enhancements were not reached consensus partially due to lack of time. The functioning is not optimized in some cases, e.g. FRF>1 with multi-beam per PCI.

6 – ESA

As expressed by Thales and Intelsat, we believe that a study is necessary first.

7 – CATT

We support to enhance beam management in Rel-18.

We have already done some investigation for beam management enhancements in Rel-17, which could be continued in Rel-18.

For non-contiguous coverage and spot beam based scenario, beam management should be enhancement.

Current NR beam mechanism assumed UE will get the beam service in any place of one cell, however, in NTN case, it might not be valid, in which cell is very large and the limited beams are not sufficient to take a full coverage. Specific beam scheduling and sweeping need to be investigated.

8 – DOCOMO Communications Lab.

Rel-17 NTN will work well, so we do not see strong motivation of this topic. Considering limited time units with a lot of potential topics in this document, we suggest to deprioritize beam management enh.

9 – ZTE Corporation

As the leftover in Rel-17, it can be considered in Rel-18 to improve the performance of LEO.

10 – NEC Telecom MODUS Ltd.

Optimization on beam measurement and reporting should be addressed in Rel-18 with higher

priority, which is critical for LEO. Solutions for reduced overhead in measurement reporting and beam failure avoidance should be considered.

11 – HUAWEI TECHNOLOGIES Co. Ltd.

We see the benefit to support enhanced beam management in particular for NR-NTN deployment above 10 GHz bands. This issue was discussed in Rel-17 NR NTN. One possible direction is to enable more efficient satellite beam switching with reduce measurement and reporting overhead in case of LEO.

12 – Nokia France

Considering the overall size of the NTN work, we suggest that this is not needed in Rel-18.

13 – NOVAMINT

We believe a study would be necessary first and we would agree with companies to de-prioritize this topic for Rel-18

14 – Fraunhofer IIS

The objective of this study is not clear to us. In particular, how this study is going to be different from the identified issues with respect to beam management in Rel17.

15 – Ericsson LM

These enhancements were already discussed at length in Rel-17 without reaching consensus, so it does not seem worthwhile to spend more time on this.

16 – CEWiT

We support to enhance beam management in Rel-18.

17 – Intel Corporation SAS

We note the moderator's request for companies to not repeat positions expressed at RAN93e. We will not repeat our views on all of the controversial topics from RAN#93e but would like it to be noted that our views have not changed relative to RP-211658.

18 – InterDigital

We are supportive for further study of beam management in Rel-18, specifically for frequency re-use factor >1, considering no enhancement was agreed due to time limitations in Rel-17.

19 – Gatehouse Satcom A/S

We express our support to de-prioritize this for Rel-18 and perform a study first.

20 – MediaTek Inc.

De-prioritize. Legacy NR beam management is sufficient, as was discussed in Rel-17 NR NTN

21 – Sony Europe B.V.

Some issues, e.g., UE location based beam management and polarization multiplexing, might not be finished within Rel-17. These leftover issues related to beam management and polarization aspects from Rel-17 discussions may hence have to be carried over into Rel-18.

22 – HUGHES Network Systems Ltd

We believe this is not a priority for Rel-18, a study first may be possible.

23 – Classon Consulting

for FUTUREWEI Medium priority, build on discussions from R17

24 – Qualcomm Incorporated

This is an important topic for UE power consumption and/or latency. It was discussed at length during Rel-17, but down-prioritized due to lack of time. We suggest the following:

Efficient beam management for the beams of a same satellite considering the following:

· UE beam switching is often highly predictable

· Switching of satellite beams often leads to frequency/BWP change but no spatial relationship/QCL change.

· Implementation limits of satellite beams.

Feedback Form 9: Study of DL PAPR reduction

1 – Eutelsat S.A.

We support this study and would draw attention to interested parties to a recently started related study within ETSI (DTR/SES-00456).

2 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We prefer to treat with lower priority due to large specification impact on waveform selection and designs.

3 – THALES

The OFDM signal may require significant back-off and hence degrade the throughput. This may especially apply the Downlink in broadband satellite networks operating above 10 GHz based on payload operating with single carrier per amplifier. However the state of the art payload for broadband satellite network operate with multi carrier per amplifier, hence the total degradation associated to OFDM signal like NR is expected to be marginal as demonstrated in R1-2005311 "Considerations on PAPR requirements for NR NTN downlink transmission", Thales.

Moreover, this study is being carried out as part of an going work item in ETSI referenced DTR/SES-00456, see https://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=63516

4 – Samsung Electronics Co.

We don't see a strong motivation of this in NTN, it would be much scope in WG.

5 – Guangdong OPPO Mobile Telecom.

It is not clear what the enhancement would be. We are not positive if the waveform is to be impacted.

6 – ESA

There is already a study carried out in the ETSI-SES group. It is a low priority in our opinion.

7 – CATT

In view of technical discussion of R17 NTN and beyond 52Ghz, new waveform has not been accepted by the majorities. Though it may bring the benefit of PAPR reduction, it might take some implementation specific techniques to reduce the PAPR.

Then in Rel-18, it is not proper to introduce additional optimizationfor PAPR reduction or new waveform.

8 – ZTE Corporation

We prefer to postpone the discussion.

9 – DOCOMO Communications Lab.

We do not see strong motivation. If different waveform is introduced, it will require quite large efforts. We do not think this can be included with a lot of other potential objectives discussed in this document. We suggest to deprioritize this topic.

10 – Nokia France

Considering the overall size of the NTN work, we suggest that this is not needed in Rel-18.

11 – NOVAMINT

Lower priority as there is already an ongoing study in ETSI-SES group

12 – Fraunhofer IIS

We consider this as an important topic for improving the throughput especially for systems operating at higher spectral efficiencies.

13 – Ericsson LM

We are not supportive of using DFT-s-OFDM in the DL.

14 – Intel Corporation SAS

We note the moderator's request for companies to not repeat positions expressed at RAN93e. We will not repeat our views on all of the controversial topics from RAN#93e but would like it to be noted that our views have not changed relative to RP-211658.

15 – InterDigital

We do not see a strong motivation and have concerns about the potential specification impact of defining a new waveform.

16 – Gatehouse Satcom A/S

We see this as a low priority as there is already an active study on this topic in the ETSI-SES group.

17 – MediaTek Inc.

Can be de-prioritized, need is unclear and can be up to gNB / satellite implementation with distortion algorithms. New waveform would have high impact on core specifications

18 – Sony Europe B.V.

DFT-S-OFDM on DL could be considered in Rel-18 for DL PAPR reduction.

19 – HUGHES Network Systems Ltd

There is already a study carried out in the ETSI-SES group. It is a low priority in our opinion.

20 – Classon Consulting

for FUTUREWEI Low priority

Feedback Form 10: Study of UE without GNSS

1 – Rakuten Mobile

we support Study of UE without GNSS .

2 – THALES

We support only a complementary study (wrt Rel-16) on this candidate enhancement. The aim of the study is to identify possible impacts from serving UE without GNSS capabilities (either no GNSS receiver or GNSS not used for operating with satellite access or temporary unavailable GNSS capability) without any normative work.

The enhancements to be studied are expected to cope with degraded GNSS performance/accuracy and hence reduced dependency of UE towards GNSS.

In particular, the study should address the following objectives:

· *Evaluate the performance of new methods for UL time & frequency sync in idle and connected mode, new PRACH [RAN1, RAN2]*

· *Define method for Doppler estimation and/or pre-compensation without dependency on GNSS [RAN1, RAN2]*

· *Backward compatibility with UE with GNSS in a given cell [RAN4-RD]*

· *Identify/evaluate alternative UE based location method to GNSS during initial access [RAN1, RAN2]*

The study will consider the necessary adaptations to NR and then may identify necessary additions for IoT if needed.

Leading WG = RAN1, Secondary WG = RAN2, RAN4-RD

Potential interaction with SA/CT: None

3 – Intelsat

We support the views shared by Thales.

4 – Eutelsat S.A.

We support this study (including UE with GNSS capability but with reduced dependency on GNSS/ operation under degraded performance). Hence we agree with the comments and clarification made by Thales above.

5 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

GNSS capability is one of the UE restrictions in Rel-17 NTN, which is expected to be eased hence allowing Rel-18 NTN to support a wider range of UE capabilities and use cases.

We think there may be some contradiction between network based UE location and study of UE without GNSS. If UE position can be determined without GNSS, there may be no necessity of the mechanisms for UE without GNSS.

If UE without GNSS is to be studied, enhancements may focus on the possible issues of existing mechanisms depending on UE position, and develop alternative solutions.

 Enhancements in time/frequency synchronization and initial access, including timing advance pre-compensation, for UE without GNSS. [RAN1, RAN2]

6 – Samsung Electronics Co.

This can be studied in Rel-18, in order not to enforce the UEs to use GNSS continuously.

7 – Guangdong OPPO Mobile Telecom.

we support to study the case without GNSS.

8 – Panasonic Corporation

We support this in conjunction with "Network based UE location" for NTN service continuity even in a circumstance where a UE cannot get a GNSS signal.

9 – ESA

We are fine with Thales' view.

10 – DOCOMO Communications Lab.

We support this topic in Rel-18 since following two use cases are typical. At least time/frequency synchronization enhancement are needed for UE without GNSS.

- UE without GNSS capability considering low cost/complexity UEs
- No GNSS coverage in some cases, e.g., indoor.

11 – CATT

We support the views shared by Thales, but think positioning a UE without GNSS capability should be studied in other SIDs, e.g., SID for NR positioning.

12 – ZTE Corporation

We are open to this part and with consideration on the compatibility issue, it may be discussed in a later release. Otherwise, the commercialization of Rel-17 UE will be challenging.

13 – CATT

More information:

For the UE without GNSS capability, there are two ways to address this issue.

- The first way is to enhance the RAT dependent positioning method,
- The second is to develop time and frequency synchronization without relying on the UE GNSS position.

In this stage, we prefer to enhance positioning method, rather develop one system design to be decoupled with UE GNSS position. Additionally, we should further investigate the potential impacts comprehensively if totally without GNSS information.

14 – NEC Telecom MODUS Ltd.

UE without GNSS is not the market trend, many design of REL17 NTN highly rely on UE's GNSS ability, so the impact on system of support UE without GNSS will be very big. we are reluctant to consider UE without GNSS.

15 – HISPASAT SA

We share Thales' view.

16 – Nokia France

This is important for scenarios when the link budget supports NTN operation but not GNSS. The objective should be:

- Enable operation without GNSS in order to increase availability of NTN services [RAN1/RAN2/RAN4].
- Study and specify methods for timing advance estimation for both initial access and connected mode
- Study and specify method for Doppler estimation and/or pre-compensation
- Study and specify mobility enhancements.

17 – LG Electronics France

We are afraid that it will bring too much work load in Rel-18 because many features defined in Rel-17 should be re-defined if GNSS is not capable.

18 – NOVAMINT

We support Study of UE without GNSS (or reduced dependency on GNSS) and the objectives as presented by Thales and Eutelsat.

We believe this study should be conducted in Rel-18 as it will be unlikely and too late to start this in future release.

19 – Fraunhofer IIS

We support this study as part of Rel18. This will widen the range of supported UEs to have NTN connectivity. We also believe that supporting UEs without GNSS complements the study on "Network-based UE location". Overall, we support the comments provided by Thales.

20 – Sateliot

We support to address this study in Rel-18 and share the view expressed by Novamint with respect to the relevance of having a 3GPP position on the feasibility of this feature not later than Rel-18.

21 – Ericsson LM

This would require a study item first. Also, it depends on network-based positioning, and therefore it should be started only after that is stable.

22 – CEWiT

Support Thales' view on this.

23 – Intel Corporation SAS

We note the moderator's request for companies to not repeat positions expressed at RAN93e. We will not repeat our views on all of the controversial topics from RAN#93e but would like it to be noted that our views have not changed relative to RP-211658.

24 – Apple AB

25 – InterDigital

We share the view that this should be studied first. However, we think this could be solved by network-based UE location topic from 1.1.1.4, which is the preferred way to support non-GNSS UEs considering the importance of location information in Rel-17.

26 – Gatehouse Satcom A/S

We support UE without GNSS (or reduced dependency on GNSS) and share the view of Thales. As well we share the view of Novamint and Sateliot in relation to the timing of this study, since later than Rel-18 is likely too late.

27 – Sony Europe B.V.

The following aspects should be studied related to UE operation without GNSS:

Modification to Initial access (UL synchronization) for UE operation without GNSS [RAN1, RAN2]

PRACH preambles enhancements given that there is no autonomous open loop TA estimation. [RAN1]

28 – MediaTek Inc.

We are not supportive of this item. The need is un-clear. It would require specification of a very different system with huge impact on the core specification, implementation, and testing. It is not backward compatible in the gNB. If the concern is GNSS not available all the time, it is very likely that in this scenario NTN also not available. UE implementation can easily use well-known and widely implemented dead-reckoning algorithms that can predict GNSS position for 10s of seconds or longer when GNSS becomes un-available. Spare use of GNSS / reduce reliance on GNSS could already be done via implementation of Rel-17 NTN with minimum or no impact on specifications.

If the proponents of this topic mean to use something else than GNSS to acquire the UE location, then there is no need for this topic assuming NTN-based position is in scope of Rel-18. RAN4 assumption for UE-pre-compensation using GNSS-acquired UE location and ephemeris for UL synchronization is GNSS accuracy of 50 meters. It should be clarified first if NTN-based position with accuracy in that order is possible. We are not supportive of a study due to limited TU budget in RAN1 and RAN2. A study would mean less time for the prioritized items.

29 – Classon Consulting

for FUTUREWEI Do not support in R18. Very large workload, unclear how often NTN is possible but GNSS is not.

Feedback Form 11: Spectrum re-use/sharing

1 – Rakuten Mobile

we support Spectrum re-use/sharing between TN & NTN . Also interference management for same.

2 – THALES

This is also of interest but it highly depends on the frequency band and its regulatory context. It may require first to down select one band for which no consensus has been identified yet.

3 – Intelsat

While this is an important topic, it may be too early to consider it for NTN.

4 – vivo Mobile Communication Co.

Since the majority of companies support coverage enhancement for commercial smartphones, spectrum re-use/sharing between NTN and TN would be necessary to support access by commercial smartphones.

5 – Guangdong OPPO Mobile Telecom.

we support to study spectrum reusing/sharing between TN and NTN.

6 – China Mobile Group Device Co.

We support this topic. Because spectrum sharing between NTN and TN may be not a corner case and is beneficial for improving spectrum utilization.

7 – CATT

We understand it's tightly related to the frequency bands to be deployed for NTN.

As the spectrums to be used for NTN are still under discussion, maybe we could wait a little bit, to discuss it in the future release.

8 – ZTE Corporation

No needed in Rel-18 since there is not a clear requirement and the band for such behavior.

9 – DOCOMO Communications Lab.

We support this study ONLY for HAPS NTN. There would be issue for satellite from regulation perspective.

In addition, other studies for HAPS that are identified in RP-211665 should be included in Rel-18 NTN scope.

10 – BT plc

We don't see any benefit to introduce such feature on NTN. We prefer to focus Rel-18 on use cases that clearly provides a benefit like NTN MBS.

11 – SoftBank Corp.

We share the same view as DOCOMO. This study is useful only for HAPS, and the whole proposal on HAPS in RP-211665 should be considered here.

12 – NEC Telecom MODUS Ltd.

It is necessary to have operators' input whether spectrum re-use/sharing is required.

13 – Nokia France

Considering the overall size of the NTN work, we suggest that this is not needed in Rel-18.

14 – Fraunhofer IIS

We support this topic and agree with Thales' approach.

15 – Deutsche Telekom AG

We have the same view with Softbank & DOCOMO. A study on spectrum re-use/sharing is useful only for HAPS. In fact, the whole proposal on HAPS in RP-211665 should be considered here.

16 – Ericsson LM

We support studying this topic.

17 – Sateliot

We support spectrum re-use/sharing between TN & NTN. As expressed by the moderator in previous discussion RP-211658, we support spectrum reuse/sharing item to be considered as part of further RAN4 Rel-18 discussions for a possible study item to assess the regulatory situation. Also we share the view on the need to be able to down-scope and focus the analysis on one or few relevant/exemplary bands of interest for the MNOs supportive of this approach.

18 – NOVAMINT

we should consider this topic for RAN4 related discussions in Q1 22

19 – Intel Corporation SAS

Study of regulatory aspects shall be done prior to any work on the spectrum sharing. Considering potentially big scope of NTN in RAN4 we can postpone this item to next releases.

20 – Apple AB

We think there is a need to collect information on the regulatory landscape before we can start thinking of technical aspects.

21 – Gatehouse Satcom A/S

We support spectrum re-use/sharing and support to further discuss this for Rel-18 in RAN4 as a possible study item to assess the regulatory situation.

22 – InterDigital

We think it is premature to discuss.

23 – HUGHES Network Systems Ltd

It is pre-mature to discuss. Without any regulatory requirement - this should be de-prioritized.

24 – Classon Consulting

for FUTUREWEI Low priority

25 – MediaTek Inc.

We support study of cellular spectrum sharing with NTN. This would reduce the scope of the study and address important regulatory aspects as a priority and potential enhancements that could be specified if found beneficial in future releases. Sharing of TN spectrum for satellite should be prioritised to address serious satellite spectrum shortage. There is simply not enough satellite spectrum, especially in sub 6 GHz. We see no issue for cellular operators to share their spectrum for satellite in the middle of deserts or territorial waters with spare or non-existent population where anyway cellular spectrum cannot be used to its full potential and is very costly deployment.

Feedback Form 12: HD-FDD capability for NTN UEs by leveraging the RedCap feature

1 – THALES

Although HD-FDD has clear benefits on the UE architecture (simplification with no need for diplexer and allowing support of a larger spectrum to cover all NTN bands below 6 GHz) , it will impact the throughput significantly. The PROs and CONs of this feature need to be further discussed.

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In addition, we propose to consider in this e-mail discussion for the Rel-18 NR-NTN evolution WI a study of NR support of HAPS based networks (complementary to the Rel-16 NR-NTN study) with the following objectives:

· *Definition of relevant HAPS scenario(s) operating in mode (to be clarified) in Mobile Service allocated spectrum (band to be clarified) with transparent/regenerative payload [RAN1/4]*

· *Identification of HAPS specific issues, if any, related to mobility and beam management [RAN1]*

· *Identification/analysis of issues associated to adjacent channel coexistence between HAPS and terrestrial networks (mode and band to be clarified) [RAN4]*

Leading WG = RAN4, Secondary WG = RAN1

Potential interaction with SA/CT: None

We suggest that the above proposed RAN1 activities for HAPS be considered as part of a Rel-18 NR-NTN evolution WI while the above proposed RAN4 activity for HAPS should be carried out as part of a specific/separate Rel-18 WI given that different RAN4 Technical Specifications may be impacted ?

2 – Intelsat

We believe the aspects mentioned by Thales for HAPS are important to consider. We believe HAPS should be considered as a part of the NTN WI, albeit refined to only consider those aspects that need work in HAPS such as RAN 4.

3 – ESA

We support HD-FDD for NTN.

4 – CATT

The motivation to enable the Redcap over NTN is still now clear.

Suggest to further consider it in future release once the Redcap is stable in TN.

5 – ZTE Corporation

For the NR-ntn, we prefer to focus on the eMBB usage firstly in Rel-18. With consideration of the application scenario for Redcap UE, the benefits to enable the service via NTN are not clear.

6 – SoftBank Corp.

On HAPS, we think Thales has raised a good point and we support their proposal. Especially, defining HAPS scenarios is critical in Rel-18 in some scope, e.g. mobility and coverage. We think it is not easy to develop common solution for NTN without having a common understanding on the scenario.

7 – DOCOMO Communications Lab.

For HAPS, also we have same view with THALES and Softbank.

8 – Nokia France

HD-FDD for RedCap over NTN could be included.

9 – Fraunhofer IIS

Scope and the need are not clear for us, whether it is more for satellite or for HAPS scenarios, as mentioned by Thales.

10 – Deutsche Telekom AG

In terms of HAPS, we believe that THALES proposal should be taken into consideration as part of NTN evolution WI. Common view with Softbank and DOCOMO.

11 – Ericsson LM

We support studying RedCap extensions for NTN.

12 – NOVAMINT

We support having a study on HD-FDD & RedCap extensions over NTN if TUs are available - i.e not removing other objectives

13 – Intel Corporation SAS

It is not clear for us which enhancements are needed to support HD-FDD for NR NTN. So, we would like to see more detailed input from the proponents of this item. From our perspective support of HD-FDD can be considered with lower priority.

14 – Apple AB

We think there is a need to collect information on the regulatory landscape before we can start thinking of technical aspects.

15 – Apple AB Please disregard the above comment (#14); it was for a different question. We are generally supportive of HD-FDD for NR NTN.
16 – Sony Europe B.V. Many issues related to HD-FDD were considered in IoT-NTN. IoT-NTN is a better starting point than Red-cap when considering HD-FDD since IoT-NTN has considered HD-FDD in the context of large propagation delay.
17 – HUGHES Network Systems Ltd We support study on HD-FDD & RedCap extensions over NTN if TUs are available
18 – MediaTek Inc. We expect the impact of this topic on specifications to be reasonable. HD-FDD support is a major enabler of NTN due to UE economies of scale in low bands (sub3GHz) (smartphone economics). It is very important to enable a single device availability across all NTN bands. With Support of HD-FDD, support for NTN is enabled without requiring any additional band-specific duplexers. Deployments in NTN-only bands (i.e. with NO TN equivalent) will likely be jeopardized by lack of availability of duplexers. We strongly recommend this topic be kept for NTN viability. Note that RedCap work can be leveraged (without consideration on Tx/Rx reductions) but additional work is needed to ensure the above.
19 – Qualcomm Incorporated If time allows, we would be open to doing a gap analysis to see what changes (hopefully small ones) are needed to enable RedCap.

1.1.2 Evolution of IoT (Internet of Things) NTN

This section will focus on the consolidating the list of objectives for the Evolution of IoT NTN. Each subsection will provide the initial set of objectives for areas that were previously discussed and summarized in RP-211658 for further refinement. **Companies should provide comments in the each associated feedback form to work towards a detailed set of objectives with proposed leading WG and secondary WGs for each objective as well as any potential interaction with SA/CT**. An initial proposal for impacted WG(s) is also provided.

1.1.2.1 IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

The moderator recommendation is to consider the list of possible objectives as a starting point for discussion. The list will need to be evaluated for priority level of each item and possible down-selection may be needed.

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1]
- Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption [RAN1]
- Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN [RAN1]

- Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN [RAN1]
- [Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage]

Feedback Form 13: IoT-NTN Performance Enhancements

1 – Rakuten Mobile

We support IoT-NTN performance enhancement specially Disabling HARQ & other topics too.

2 – THALES

We support this candidate enhancement in Rel-18.

We agree in general with the set of objectives. However, shouldn't the following objective be addressed under "Further enhancement to discontinuous coverage" and potentially, it is planned to be covered in Rel-17 IoT-NTN WI at least for geostationary satellite (FFS for NGSO):

· *[Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage]*

Leading WG = RAN1, Secondary WG = RAN2

Potential interaction with SA/CT: None

3 – Intelsat

We support the views of Rakuten Mobile, and Thales.

4 – Eutelsat S.A.

Agree with Thales (noting this may not be a complete list). We are not so clear on the benefit of PUR for NGSO but other power saving techniques could be considered to improve performance under discontinuous coverage.

5 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

Considering limited time in Rel-18 IoT NTN, it should be prioritized to solve remaining issues from Rel-17 IoT NTN.

 For the fifth bullet (Further power saving enhancements including PUR for IoT NTN), suggest removing "to support discontinuous coverage" as it can be included in objectives for discontinuous coverage. For Rel-17 PUR is assumed to be used in GEO and no further enhancement is made for LEO. Rel-18 may start to discuss possible enhancement to PUR for GEO and LEO.

6 – Samsung Electronics Co.

We are fine with Disabling HARQ feedback and Improved GNSS operations.

Mechanisms for NB-IoT NTN to mitigate packet interruption seems a RAN2 discussion.

For PUR, it is supported in Rel-17 for GEO. Support of PUR for NGSO can be part of Rel-18.

7 – Spreadtrum Communications

We think the following objectives can be prioritized:

- Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption [RAN1]

- Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN [RAN1]

- Further power saving enhancements including PUR in NGSO

Furthermore, the following bullet need to be further clarified:

- Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN [RAN1]

8 – ESA

We support this candidate enhancement in Rel-18.

9 – China Mobile Group Device Co.

Support the objectives.

10 – CATT

Share the view with Thales, we support this candidate enhancement in Rel-18.

For the 3rd bullet "*Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN [RAN1]*", we would like to clarify that only to address for NB-IoT carrier selection, or work on the full package of coverage enhancement? If we consider the coverage enhancement in Rel-18, other impacts should also be considered.

11 – ZTE Corporation

Regarding the performance enhancement, at least, the leftover in Rel-17 is preferred including disabling of HARQ feedback and improved GNSS operations during long connection.

12 – Beijing Xiaomi Mobile Software

HARQ disabling and GNSS operation during long connection should be prioritized as these have been studied in Rel-17. Other topics can be deprioritized.

13 – NEC Corporation

NEC suggests the following Rel-17 leftovers as first priority:

- Disabling of HARQ feedback
- Mechanisms for NB-IoT NTN to mitigate packet interruption
- Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage

14 – HISPASAT SA

We support this candidate enhancement.

15 – Guangdong OPPO Mobile Telecom.

we support

16 – HUAWEI TECHNOLOGIES Co. Ltd.

On improved GNSS operations for a new position fix for UE pre-compensation during long connection times, similar proposals are being discussed in Rel-17, e.g. UE reports GNSS position fix validity duration to the eNB. This kind of UE assist information can be used by the network to either schedule another position fix. If this was specified in Rel-17, it is not clear what additional enhancement is needed in Rel-18.

On support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN, it is not clear what specification impact is actually needed. So we suggest proponent to clarify the expected specification impact.

On mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption, we think this is more related to mobility enhancement which should be discussed in the mobility enhancement part.

We therefore suggest the following objectives

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1]
- Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage [RAN1, RAN2]

17 – Nokia France

Considering that the priority at present is to finalise the Rel-17 work, there are too many objectives listed here. The most interesting from our perspective is improved GNSS operations for a new position fix for UE pre-compensation during long connection times.

18 – NOVAMINT

We support this candidate enhancement in Rel-18 and the general set of objectives and we agree with the comments made by Thales on the objective related to *"Further power saving enhancements including PUR for IoT NTN ..."*

19 – Sateliot

We support this candidate enhancement in Rel-18

20 – Ericsson LM

We support studying power reduction for IoT NTN devices. On the other hand, Pre-configured Uplink Resources do not seem useful, as they would work only for the GEO case (for which there is no problem with discontinuous coverage, which PUR addresses).

21 – Intel Corporation SAS

We have the following comments on the above bullet points provided by the moderator

· For point 1: RAN2 should be included as secondary WG since there may be some impact on RAN2 specification.

· For points 2 and 5: GNSS validity with related UE behavior as well as PUR feature are currently under discussion in the Rel-17 WI, so it is too early to consider it for Rel-18

· For point 3: It's not quite clear which enhancement is needed, since in R17 RAN2 is working on NB-IoT carrier selection and support of NTN. Proponent companies may provide further clarification on the issue for the combination.

· For point 4: The leading group should be RAN2, as it's mainly about fast radio link recovery which has been touched in R17 RAN2 but no time to pursue.

22 – VODAFONE Group Plc

We support work in this area, but we need to be careful on the workload. At least

Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1]

seems useful.

23 – Apple AB

24 – Gatehouse Satcom A/S

We support this candidate enhancement and agree with Thales' view. Power saving techniques could be considered to improve performance under discontinuous coverage.

25 – InterDigital

We support Moderator's proposal. We think disabling HARQ feedback would also impact RAN2, and suggest modifying the first bullet to [RAN1, RAN2].

26 – Sony Europe B.V.

The Rel-17 IoT-NTN study item was finished early in order to focus on essential minimum functionality. The study of performance enhancements for IoT-NTN was hence curtailed. At the start of Rel-18, we think that there should be a study phase on improving the performance of IoT-NTN to meet the 5G mMTC performance requirements in terms of battery efficiency, latency, capacity and coverage.

In terms of specific objectives that were mentioned by the moderator, we have the following comments:

Disabling HARQ feedback doesn't mitigate HARQ stalling since the eNB can schedule the UE while ignoring the HARQ feedback. Disabling HARQ feedback just saves UL PUCCH resource and the associated UE transmit energy.

The objective on mitigating packet interruption needs clarifying. What "packet interruption" is being discussed. Why is this only an NB-IoT-specific issue? Why doesn't this also apply to eMTC?

We agree that we should focus of further power saving enhancements, but this should be part of a more general study phase on IoT-NTN performance improvement. It is unclear why we are homing in on PUR, which may be supported in Rel-17 in any case. It is also unclear what the specific issue is with discontinuous coverage for PUR.

27 – HUGHES Network Systems Ltd

We support this candidate enhancement in Rel-18.

28 – Classon Consulting for FUTUREWEI OK with HARQ disabling
29 – MediaTek Inc. Support the following as priorities: 1. Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates as first priority. It is especially needed for NGSO 2. Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption as a second priority 3. Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption
30 – Qualcomm Incorporated We support disabling of HARQ to prevent throughput degradation. As far as "improved GNSS operations" go, we need to be more specific about what we are referring to here. One option could be to not re-design the PRACH and assume that PRACH (e.g., for initial access) is always transmitted with valid pre-compensation, derived—at least in part—using a GNSS fix, while for subsequent operation in CONNECTED mode, we use closed-loop time and frequency correction mechanisms to obviate further GNSS fixes. The other option would be to specify entirely GNSS-free operation, including a re-design of PRACH to handle large time and frequency offsets. We are not sure that NB-IoT carrier selection based on coverage level is a RAN1 issue. This is being dealt with separately in RAN2 (for terrestrial NB-IoT) in Rel17. Therefore the responsible group for that objective should be RAN2.

1.1.2.2 Mobility enhancements

The moderator recommendation is to consider the list of possible objectives as a starting point for discussion based on the principle of small incremental enhancements to existing IoT features. The details of each objective will need further refinement. The list will need to be evaluated for priority level of each item and possible down-selection may be needed. More detail needs to be added for any items listed as enhancements. Please add your views with specific actionable objectives for any items listed as enhancements.

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC
- Reduce handover signaling overhead
- RACH congestion reduction
- Support of neighbor cell measurements and corresponding measurement triggering before RLF [RAN1, RAN2]
- Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment [RAN1]
- Enhancements on RLF and RRC reestablishment
- IoT-NTN and TN mobility enhancement
- Beam-level mobility [RAN1, RAN2]

– Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells

Feedback Form 14: Mobility enhancements

1 – Rakuten Mobile

We support mobility enhancement such as location based/Time based CHO, RACH Congestion & other topics too.

2 – THALES

We support this candidate enhancement in Rel-18.

However, some objectives should be clarified, for example

- *RACH congestion reduction*
- *IoT-NTN and TN mobility enhancement*
- *Beam-level mobility [RAN1, RAN2]*
- *Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells*

Besides the following objectives may be redundant:

- *"Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC" and "Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment [RAN1]"*
- *"Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment [RAN1]" and "Enhancements on RLF and RRC reestablishment"*

Leading WG = RAN1, Secondary WG = RAN2

Potential interaction with SA/CT: None

3 – Eutelsat S.A.

RACH congestion is an important topic, but we agree with Thales in that we would also like to see the objectives clarified and possibly more narrowly focused.

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

The enhancements to Rel-17 NR NTN mobility can be partially or fully considered for eMTC. And with similar principle the conditional RRC reestablishment can be studied for NB-IoT mobility. RAN2 shall be the leading WG for mobility-related topics. We think the following objectives can be prioritized:

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC. [RAN2]
- Support of neighbor cell measurements and corresponding measurement triggering before RLF [RAN1, RAN2]
- Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]

5 – Samsung Electronics Co.

Regarding reducing handover signaling and RACH congestion, we think these topics are not a priority in Rel-18. We are open to consider IoT-NTN and TN mobility enhancement, and beam-level mobility especially if it is in Rel-18 NR NTN.

6 – Spreadtrum Communications

We think the following objectives can be prioritized:

- Support of neighbor cell measurements and corresponding measurement triggering before RLF [RAN1, RAN2]
- Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment [RAN1]
- Enhancements on RLF and RRC reestablishment [RAN2]
- Beam-level mobility [RAN1, RAN2]
- Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells [RAN1, RAN2]

7 – ESA

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

8 – China Mobile Group Device Co.

We tend to study the first two and the fifth to the seventh objectives firstly. We are also ok for other objectives if time is enough.

9 – CATT

We support this candidate enhancement in Rel-18.

For the "*legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment*", it's under discussion in IoT NTN Rel-17, keep it here means to make further enhancement on that?

We would like to clarify do we really need the both mechanisms from "NR NTN Rel-17" and "legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment"?

For "IoT-NTN and TN mobility enhancement", maybe it could be further considered in the future release, due to:

- Mobility mechanism between TN and NTN are not well designed in NR NTN Rel-17, and to be further worked in Rel-18. Thus, it's not proper to reuse the design from NR NTN.
- The requirement should be further clarified, support both RAT types will increase the cost of the UE.

10 – ZTE Corporation

We are open to defining the solution for

- PRACH enhancement to improve the supported UE density and RACH congestion reduction
- Neighbor cell measurements and corresponding measurement triggering before RLF.

Regarding others, the necessity is not clear and the corresponding time consumption is also one issue.

11 – Beijing Xiaomi Mobile Software

We are supportive to have this topic in the Rel-18 IoT NTN and it should be led by RAN2.

For CHO based handover, Rel-17 IoT NTN only support the Rel-16 CHO, so the location based CHO and timing based CHO can be considered for Rel-18.

The existing RLF and RRC reestablishment based on the T310 may lead to service interruption and UE power consumption, so the enhancement is necessary.

For IoT-NTN and TN mobility enhancement, in Rel-17, only consider the mobility in IoT-NTN network, so in Rel-18, the mobility between IoT-NTN and eMTC/NB-IoT should be considered.

Based on the previous discussion, a potentially very large number of UEs may need to perform HO at a given time, leading to possibly large signalling overhead and service continuity challenges. So the Reduce handover signaling overhead should be considered.

So we think the following objectives should be studied/specified with priority.

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]
- Enhancements on RLF and RRC reestablishment [RAN2]
- IoT-NTN and TN mobility enhancement [RAN2]
- Reduce handover signaling overhead [RAN2],

12 – NEC Corporation

NEC suggests the following objectives as first priority:

- CHO for eMTC: Previous works done in NR is a good reference.
- Enhancements on RLF and RRC reestablishment: This can improve the performance of the support of discontinuous coverage which we thought very important for Rel-18. (Rel-17 aims to support discontinuous coverage without excessive failures / recovery actions.)

And for issues below not specific to IoT-NTN, we propose to discuss them in NR NTN first then figure out the gap for IoT-NTN case.

- RACH congestion
- NTN and TN mobility enhancement
- Reduce handover signaling overhead

13 – HISPASAT SA

We support this candidate enhancement and share Thales' view.

14 – HUAWEI TECHNOLOGIES Co. Ltd.

The listed objectives are not in the same level of details.

We are fine with the following bullet:

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]

The following proposal has been included in Rel-17 and it is not clear what needs to be enhanced in Rel-18:

- Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment [RAN1]

The following bullets are not relevant to mobility enhancement:

- RACH congestion reduction
- Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells

The following proposals are lack of details:

- Reduce handover signaling overhead
- Enhancements on RLF and RRC reestablishment
- IoT-NTN and TN mobility enhancement
- Beam-level mobility

15 – Nokia France

LTE CHO has already been discussed for eMTC, so it is not clear why it is included here.

The concept of beams does not exist in LTE in the same way as NR; hence "beam-level mobility" does not make sense to include here.

Overall, considering that the priority at present is to finalise the Rel-17 work, there are too many objectives listed.

16 – NOVAMINT

We support this candidate enhancement in Rel-18 and we agree with the comments made by Thales on the objectives – some need to be clarified and some are redundant and even may be already addressed in Rel-17.

In our view, Beam-level mobility (with Multiple satellite beams in one IoT NTN cell) is a new enhancement which needs to be part of the prioritized objectives.

17 – Sateliot

We support this candidate enhancement in Rel-18 and are fine with Thales' view.

18 – Ericsson LM

In general, we support studying mobility enhancements, but to avoid market fragmentation we should avoid different "flavors" of IoT only for NTN. Therefore, LTE-M and NB-IoT should be treated on the same level, and the differences between the two technologies should maintained (e.g. there should be no connected mode mobility for NB-IoT).

19 – Ericsson LM

Working on efficient power saving mechanisms seems agreeable, with the understanding that the intention is to enhance existing mechanisms (i.e. eDRX/PSM). "Improvements to UE mobility" is a very generic description; enhancing idle-mode procedures might be feasible, however even from Rel-17 discussions it is unclear whether there is any need to specify anything or just leave to implementation (note that such flexibility already exists in legacy). On connected mode, considering that connections are expected to be short and the UE is expected to know when there is no coverage, it can be safely left to the UE and the network when to trigger data transmission in UL or DL (and this is especially true for NB-IoT, where mobility is not supported). For this reason, it does not seem justified to enhance RLF and RRC re-establishment for mobility purposes. On the other hand, it may make sense to enhance handover mechanisms for NR NTN devices so that service continues once the UE is back in coverage (provided the coverage gaps are not too large, e.g. few minutes). On "network-controlled mobility and multiple non-anchor carriers": today the mobility is controlled by the network, so this objective does not seem meaningful if formulated like this. We should either clarify or remove it.

20 – Ericsson LM

Please DISREGARD the previous comment, as it was posted in the wrong form. The correct one is as follows.
In general, we support studying mobility enhancements, but to avoid market fragmentation we should avoid different "flavors" of IoT only for NTN. Therefore, LTE-M and NB-IoT should be treated on the same level, and the differences between the two technologies should maintained (e.g. there should be no connected mode mobility for NB-IoT).

21 – Intel Corporation SAS

There are overlaps between these bullets, and we suggest to categorize them as below:

RAN2 part:

First priority:

· Solutions introduced in Rel-17 NR NTN can be considered (e.g. timing-based CHO) for eMTC

· Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment [RAN1]

Second priority:

· Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO) for eMTC

· Support of neighbor cell measurements and corresponding measurement triggering before RLF [RAN1, RAN2]

· Enhancements on RLF and RRC reestablishment

Third priority:

· Reduce handover signaling overhead

· RACH congestion reduction

· IoT-NTN and TN mobility enhancement

RAN1 part:

· Beam-level mobility [RAN1, RAN2]

· Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells

22 – VODAFONE Group Plc

We are not yet convinced that these enhancements will add much value over Rel 17, but if RACH Congestion will be an issue, then this would be useful to solve.

23 – Apple AB

24 – Gatehouse Satcom A/S

We support this mobility enhancement and agree with Thales' view. The Beam-Level Mobility is a new enhancement and should be added as a prioritized objective.

25 – InterDigital

Support Moderator's proposal, with priority given to bullets 1 and 4-7. To minimize specification effort, we should leverage as much as possible work done in Rel-17 NR NTN.

26 – Sony Europe B.V.

We see merit in many of the objectives suggested by the moderator. We would also like to include an objective on

- Service continuity between IoT NTN and IoT TN [RAN2]

The "RACH congestion reduction" is applicable not only to mobility. There is also a PRACH congestion problem following ephemeris transmission on SIB. IoT-NTN UEs will wait for ephemeris information on SIB before attempting initial access. Hence there will be PRACH congestion following ephemeris transmission on SIB. Rel-18 should look at PRACH congestion as a whole rather than just focussing on the mobility-induced PRACH congestion.

27 – Classon Consulting

for FUTUREWEI Too many objectives

28 – HUGHES Network Systems Ltd

We support this candidate enhancement in Rel-18 and share Thales' view.

29 – MediaTek Inc.

The scope is very wide. Prioritise the following:

1. Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration [RAN2]

2. Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment for NB-IoT to mitigate packet interruption and signalling overhead [RAN2]

30 – Qualcomm Incorporated

We are generally fine with Moderator's recommendation with comments on the following items.

Beam-level mobility is inextricably tied to the notion of "Ncells with multiple anchor carriers (e.g., at least one anchor carrier per satellite beam)" for NB-IoT, without which beam-level mobility isn't straightforwardly conceivable. In our assessment, these should be taken together. Also, beam-level mobility is a somewhat broad term, encompassing aspects such as some form of beam quality metrics (estimation and/or reporting), UE procedures for beam failure recovery and beam switching, etc. We could flesh these things out, as we make progress towards writing an eventual work item. Still, we strongly believe that beam-based mobility (especially for LEO) should be a high priority item for IoT-NTN evolution in Release 18.

As for continuing ***the same*** long PDSCH/PUSCH transmissions between cells—we don't know how realistic that is. The utility of beam-based mobility, to us, is primarily in being able to continue communication with the network after changing beams (**say transmitting k out of N packets from the UE buffer over beam 1, followed by transmitting the remaining N-k packets over beam 2**), without having to go through RRC-based procedures every time the best serving beam changes. However, these **don't necessarily pertain to continuing the "same" PDSCH/PUSCH**, which we think is incredibly complex, and potentially infeasible.

1.1.2.3 Further enhancement to discontinuous coverage

The moderator recommendation is to consider the list of possible objectives below as a starting point for discussion. The list will need to be evaluated for priority level of each item and possible down-selection may be needed.

- Efficient power saving mechanisms (eDRX/PSM) for sparse satellite constellations [RAN2]
- Improvements to UE mobility among sparse cells [RAN2]
- Network-controlled mobility and multiple non-anchor carriers may be taken into account [RAN2, RAN3]

Feedback Form 15: Further enhancement to discontinuous coverage

1 – Rakuten Mobile

We support Further enhancement to discontinuous coverage & also power saving schemes to avoid discontinuous coverage.

2 – THALES

We support this candidate enhancement in Rel-18.

We agree with the set of objectives.

Leading WG = RAN2, Secondary WG = RAN3

Potential interaction with SA/CT: with SA2 and CTx WGs with respect the improvements related to the operation under discontinuous coverage, which is expected to be addressed from system architectural level and core network functionality in Rel-18.

3 – Eutelsat S.A.

This is a very important feature that will benefit from enhancement. We agree with the proposal and agree with Thales that there is likely to be the need to interact with SA/CT WGs.

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

Discontinuous coverage is an important commercial scenario for IoT NTN, wherein satellite access can be provided by operators with sparse constellation and lower cost. In Rel-17 satellite assistance information is to be defined to help UE predicting coverage holes.

- For the first bullet, some possible directions of enhancements can be listed, e.g. enhancements in PSM timers requesting and configurations. [RAN2]
- For the second bullet, CHO and conditional RRC reestablishment/recovery for coverage interruption can be considered. [RAN2]
- Further enhancement on assistance information e.g. UE-NW interaction and alignment on understanding of coverage holes. [RAN2]

5 – Spreadtrum Communications

We support further enhancement to discontinuous coverage and the list of possible objectives.

6 – ESA

We support this candidate enhancement in Rel-18. This is a very important feature.

7 – China Mobile Group Device Co.

Support all the objectives and prefer to s discuss the first one with high priority.

8 – CATT

We support this candidate enhancement in Rel-18.

We have done some investigation work in Rel-17, but as SA/CT will work on this in Rel-18, RAN groups should continue the work in Rel-18 with the coordination with SA/CT.

9 – ZTE Corporation

Similar to mobility, this is part is also up to the Rel-17 progress. Based on the legacy solution, once the critical issues have been identified, we may can further consider the enhancement as:

- Power saving enhancement including efficient eDRX/PSM and PUR for sparse satellite constellations. [RAN2, RAN3]
- Enhancements on RLF and RRC reestablishment[RAN2]

10 – Beijing Xiaomi Mobile Software

In Rel-17, due to time limitation, only solutions without SA and CT impact are discussed for RRC idle UE. In Rel-18, the complete solution for RRC idle and RRC Connected UE should be provided. We support to study and specify the following objectives with priority.

- Efficient power saving mechanisms (eDRX/PSM) for sparse satellite constellations [RAN2]
- Improvements to UE mobility among sparse cells [RAN2]

11 – NEC Corporation

The main difference compared to NR NTN is that power saving is more important. Considering the limited time budget of Rel-17, we propose to study efficient power saving mechanisms for sparse satellite constellations in Rel-18.

12 – HISPASAT SA

We support the enhancement of this feature in Rel-18.

13 – Guangdong OPPO Mobile Telecom.

we support

14 – HUAWEI TECHNOLOGIES Co. Ltd.

The first two bullets have already been discussed in Rel-17 IoT-NTN and even though SA2 has decided not to support discontinuous coverage in Rel-17. At RAN#93, RAN asks SA and CT to (re)consider supporting new functionality to support discontinuous coverage in Rel-17. Since there is still no reply from SA2 and CT1 yet, it is better to wait for more progress.

The last bullet is lack of details.

15 – Nokia France

These aspects could be considered if time permits. As in Rel-17, it should be a separate work item from NR-NTN as it is a separate RAT and separate specifications. Note also that the details of Rel-17 are still unclear, so it is not possible yet to define the scope of any enhancements.

16 – NOVAMINT

We support this candidate enhancement in Rel-18 as this an important feature to further develop and enhance in R18.

17 – Sateliot

While we expect to have a minimum workable solution for discontinous coverage under Rel-17, we support addressing any Rel-17 leftover as well as further enhancements in Rel-18.

18 – Ericsson LM

Working on efficient power saving mechanisms seems agreeable, with the understanding that the intention is to enhance existing mechanisms (i.e. eDRX/PSM). On “improvements to UE mobility”, we note that this is a very generic description; enhancing idle-mode procedures might be feasible, however even from Rel-17 discussions it is unclear whether there is any need to specify anything or just leave to implementation (note that such flexibility already exists in legacy). On connected mode, considering that connections are expected to be short and the UE is expected to know when there is no coverage, it can be safely left to the UE and the network when to trigger data transmission in UL or DL (and this is especially true for NB-IoT, where mobility is not supported). For this reason, we do not support enhancing RLF and RRC re-establishment for mobility purposes. On the other hand, it may make sense to enhance handover mechanisms for NR NTN devices so that service continues once the UE is back in coverage (provided the coverage gaps are not

too large, e.g. few minutes), On "network-controlled mobility and multiple non-anchor carriers": today the mobility is controlled by the network, so this objective does not seem meaningful if formulated like this. We should either clarify or remove it.

19 – Intel Corporation SAS

Generally, we are OK with the list of the items provided by the moderator. Also, some aspects for discontinuous coverage are still under discussion in RAN2 so we may need to revisit the scope after November WG meeting.

20 – VODAFONE Group Plc

We should check what is achievable in rel 17 first - currently (22/10/21) SA2 seem to have found a simple, workable solution.

21 – Apple AB

22 – InterDigital

Support Moderator's proposal. We think enhancements to detection and reporting of coverage gap could also be considered, however this may depend on progress in Rel-17.

23 – Sony Europe B.V.

We are supportive of enhancements to support discontinuous coverage.

24 – Classon Consulting

for FUTUREWEI OK with studying efficient power savings mechanisms (eDRX/PSM)

25 – HUGHES Network Systems Ltd

We support further enhancement to discontinuous coverage & power saving schemes to avoid discontinuous coverage.

26 – MediaTek Inc.

It could be sufficient to specify store-and-forward mechanisms with RAN2/SA2, which we see as essential for this topic to ensure global IoT coverage. Rel-17 should address this issue based on long-term prediction using ephemeris and GNSS location, and alignment of paging windows and eDRX window.

27 – Qualcomm Incorporated

Given that discontinuous coverage will have limited support in Rel-17 due to no SA/CT work, we are supportive of completing the work in Rel-18, maybe together with 'store and forward' components.

1.1.2.4 Other comments for controversial topics identified in RP-211658

This section will focus on driving to consensus on previously identified controversial topics in RP-211658 if compromise can be achieved. There is no need to repeat positions expressed in the RAN93e Rel-18 Prep discussion.

Proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18

Prep discussion when presenting possible solutions. There is a feedback form for each controversial topic for companies to add any proposals for compromise and/or way forward on a set of objectives for each topic that might be agreeable.

Feedback Form 16: Support for store-and-forward on-board NTN payload

1 – THALES

We also support this candidate enhancement in Rel-18 since Store-and-forward (S&F) will allow a NTN vehicle to provide service to IoT NTN devices even in periods/areas when/where the NTN vehicle is not connected to a Gateway on the ground. eNB on board architecture is assumed.

We propose the following set of objectives.

- *Support of decoupled signalling procedures "UE <-> Satellite with onboard RAN node" and "Satellite with onboard RAN node <-> CN on the ground" for achieving end-to-end functionality. [RAN2, RAN3]*
- *Dynamic attachment between S-GW and eNB [RAN3]*
- *Network identity handling, cell activation associated to moving RAN nodes. [RAN3]*
- *UE's power saving [RAN2]*

Leading WG = RAN3, Secondary WG = RAN2

Potential interactions with SA/CT:

- *with SA2 and CTx WGs with respect to store and forward operation, which is expected to be addressed from system architectural level and core network functionality in Rel-18.*
- *with SA2 with respect to 'store and forward'. SA2 may consider develop generic S&F IoT UE-UE-NW architecture with usage of sidelink relay where S&F can happen at any of these elements.*

2 – Eutelsat S.A.

We consider this an important feature to develop in R18. It is suited to delay tolerant IoT services and permits the use of fewer ground stations than with R17 as UE to Network data can be stored onboard until a feeder link becomes available (this latter point as noted by Thales requires "decoupled signalling procedures").

3 – Samsung Electronics Co.

This can be considered for IoT over NTN after it has been studied/specified in NR NTN.

4 – ESA

We support this candidate enhancement in Rel-18. We are fine with Thales' view.

5 – China Mobile Group Device Co.

It is acceptable to us to discuss this if time allows.

6 – CATT

We think coordination with SA/CT is needed to support this candidate enhancement in Rel-18.

Moreover, it makes much more sense to support store-and-forward for regenerative payload case, so the generative payload should be supported first. Therefore, the regenerative option, i.e. "gNB on board" is most essential and should be prioritized in Rel-18.

7 – ZTE Corporation

We are negative on this aspect since the benefits compared to other solution to improve the service continuity is not clear. Moreover, such behavior requires more investigation on the higher layer design including potential checking on the security issue. We prefer to postpone it in the future and focus on the typical deployment scenario.

8 – HISPASAT SA

We support this candidate enhancement in Rel-18 and share Thales's views.

9 – Nokia France

The priority at present is to complete the ongoing Rel-17 work. Further enhancements might be considered in Rel-19.

10 – Sateliot

We think this candidate enhancement is very important for Rel-18 and share Thales and Eutelsat views.

In the same way that the support of discontinuous coverage will facilitate initial market entry with small constellations, the support of store and forward operation for delay-tolerant IoT services will facilitate providing global coverage with a reduced number of Ground Stations.

The realization of store and forward operation also have clear impacts on system architecture and CN functionality, so alignment with SA/CT groups is necessary.

11 – NOVAMINT

We support this candidate enhancement in Rel-18 as it will allow further cost effective commercial solutions for the benefits of the market. We believe it would be a limited effort in RAN which should be aligned with system architectural level and core network functionality which it is expected to be addressed in Rel-18.

12 – Ericsson LM

This might have a very large impact on SA/CT; it seems appropriate to seek coordination with those groups first.

13 – VODAFONE Group Plc

The regulatory impacts of this may make it unviable.

14 – Apple AB

15 – InterDigital

We think the priority would be to conclude on leftovers from Rel-17. This may be considered if time allows.

16 – HUGHES Network Systems Ltd We think this candidate enhancement is important for Rel-18 and share Thales and Eutelsat views.
17 – MediaTek Inc. Support this topic with priority in RAN2 / SA2, which we see as essential for this topic to ensure global IoT coverage. It seems related to our previous comment on discontinuous coverage.
18 – Qualcomm Incorporated If regenerative payload is supported with store-and-forward on-board, then there may not be a need to declare discontinuous coverage just because there is no feeder link available. Therefore, we think that this also needs to be considered together with discontinuous coverage.

1.2 Moderator Summary and recommendation for further discussion

Thanks for the detailed input and discussion during the Initial Round. The list of areas/objectives for NTN Evolution is taking shape.

After consideration of all of the company input, the moderator recommends further refinement of the items listed in the Intermediate Round working towards initial convergence on the areas/objectives of each item, agreement on proposed leading WG and secondary leading WG(s), and agreement on the proposed potential interaction with SA/CT during the Intermediate Round. The moderator has provided an Intermediate Round recommendation for each topic to consider when presenting your input during the Intermediate Round. Based on the outcome of the Intermediate Round, the moderator will provide an initial draft WID with an initial draft of the overall justification and the proposed final list of areas/objectives for further discussion during the Final Round.

2 Intermediate Round

2.1 Collection of company views

2.1.1 Evolution of NR NTN (Non-Terrestrial Networks)

Please provide any input on the overall justification section for the proposed WID for Evolution of NR NTN. At this time, the topics of Evolution of NR NTN and Evolution of IoT NTN are kept separate for email discussion purposes. As it is not yet confirmed if they will be handled together or as separate WIDs, please provide the overall justification for Evolution of NR NTN separately at this time.

Feedback Form 17: Evolution of NR NTN Justification

1 – MediaTek Inc. We are generally supportive of moderator proposal. We think some further de-scoping and prioritization will be needed to ensure RAN1 and RAN2 objectives can be completed with Rel-18 timeframe and TU budget allocation. Discussions should focus on the non-controversial topics
2 – ZTE Corporation

Regarding the objectives for each topic, whether it can be done as WI directly or starting with the SI phase should be well defined. For the potential objectives for following WIs, the decision should be made later up to the study.

3 – Apple AB

We are supportive of the overall justification. For the objectives for SI phase, details can be decided a bit later as well.

4 – Classon Consulting

for FUTUREWEI The sum of the scope still looks to be several times more than can be fit into a single release for NTN.

5 – China Mobile Group Device Co.

Currently, the objectives provided under each topic are still a little more. And we are fine about the proposal suggested by the moderator to further refine the scope.

6 – Qualcomm Incorporated

Only features that are essential for basic NTN access have been considered in Rel-17 NR-NTN. Support of important use cases and deployment scalability are not considered. Without further evolution of NR-NTN, support of smart phones in NTN may require constellations that are economically infeasible.

7 – Beijing Xiaomi Mobile Software

Genarally fine, but further down-scope may be needed.

8 – THALES

Here under our proposed input for the overall justification section for the proposed WID for Evolution of NR NTN:

In Release 17, a work item was carried out to define solutions enabling New Radio and NG-RAN to support Non-Terrestrial Networks (NTN):

- *Transparent payload based NGSO network scenarios (down to 600 km altitude) addressing at least 3GPP class 3 UE with GNSS capability in both Earth fixed &/or moving cell configurations*
- *Transparent payload based GEO network scenarios addressing UE with GNSS capability*

As part of Release 18, a new work item is proposed to define enhancements for NG-RAN based Non-Terrestrial Networks in order to

· *Support new scenarios to cover deployments in frequency bands above 10 GHz*

· *Offer optimized performance especially when addressing handset terminals w.r.t. coverage and mobility*

· *Address requirements associated with regulated services regarding a network verified UE location i.e. to be able to check the UE reported location information.*

· *Support new capabilities like multi-connectivity involving at least one NTN access*

9 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We support the moderator's proposal and think the Rel-18 NR NTN shall focus on:

1) features that are essential to expand the commercial market of NTN, e.g. support of more types of UEs; and

2) the applicability of the solutions developed by general NR enhancements, and identify issues and solutions considering the NTN characteristics including large propagation delay and satellite movement.

From this perspective and considering time budget, we are fine to prioritize the topics with majority consensus.

10 – CATT

In Rel-16, several architecture options for NR NTN have been studied and captured in TR 38.821. While in Rel-17, only the transparent payload is considered in the WI phase.

NTN Rel-17 Work Item aims to work on a very basic architecture option, i.e. supports LEO/GEO with transparent payload only. Even though, some of the use cases are not addressed or low prioritized, e.g. Coverage enhancement, Mobility between TN and NTN. To make the NTN system works better, further enhancement seems necessary.

Via the ISL, the coverage of the NTN system could be further extended, considering the Regenerative payload and Inter Satellite Link (ISL) could provide more flexible deployment choices. Compared to transparent payload, Regenerative network could provide shorter latency for UE access. Regenerative payload and ISL could also enable the direct communications and more efficient resource coordination between on-board gNBs. Thus, it's essential to support regenerative payload and ISL in Rel-18.

11 – Ericsson LM

In general we agree with the proposed handling.

12 – NOVAMINT

We would support the justification text proposed by Thales

13 – HUGHES Network Systems Ltd

We proposed the Release 18 new work item to define enhancements for NG-RAN based NTN:

- Support new scenarios to cover deployments in frequency bands above 10 GHz ·
- Offer optimized performance especially when addressing handset terminals w.r.t. coverage and mobility ·
- Address requirements associated with regulated services regarding a network verified UE location
- Support new capabilities like multi-connectivity involving at least one NTN access

14 – HUAWEI TECHNOLOGIES Co. Ltd.

The Rel-17 NTN work item specifies the enhancements identified for non-terrestrial networks especially LEO and GEO with implicit compatibility to support HAPS (high altitude platform station) and ATG (air to ground) scenarios with following assumptions:

- FDD is assumed for core specification work for NR-NTN.
- Earth fixed Tracking area is assumed with Earth fixed and moving cells.
- UEs with GNSS capabilities are assumed.
- Transparent payload is assumed

In Rel-18, there is a need to extend the support of NTN to more frequency bands and to improve coverage performance for different services in different deployment scenarios.

15 – Gatehouse Satcom A/S

We support Thales' justification text, though additionally we see a need for further de-scoping and prioritization, to ensure RAN1 and RAN2 objectives can be completed in respect to the Rel-18 TU allocations and timeframe.

16 – HISPASAT SA

We support justification from Thales.

2.1.1.1 Coverage enhancements

Leading WG = RAN1, Secondary WG = RAN2

Potential interaction with SA/CT: Interaction with SA2 & SA4 with respect to the potential low-rate codecs performance enhancements for in link budget limited context.

The Rel-18 NTN objectives shall focus on the applicability of the solutions developed by general NR coverage enhancement to NTN, and identify potential issues and enhancements if necessary, considering the NTN characteristics including large propagation delay and satellite movement. NTN-specific characteristics are to be included in this coverage enhancement work, otherwise it can be part of another WI (e.g., UL enhancement of coverage). The objectives need to cover the use case of voice and low-data rate services using commercial smartphones with more realistic assumptions on antenna gains, e.g., -5dBi instead of 0dBi typically assumed for link budget analysis for terrestrial networks.

- Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN [RAN1]

After conclusion of the evaluation above, the following candidate set of NTN-specific objectives, if needed, are listed.

- Study and specify repetitions enhancements beyond techniques covered in Rel-17 CovEnh WI for the relevant channels [RAN1]
- Study and specify NTN-specific diversity techniques for the relevant channels [RAN1]

– Improve the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead for VoNR [RAN1,RAN2] [Liaise with SA2/SA4 as necessary]

The following candidate objectives will need additional justification if they are to be included in the initial list of candidate objectives. Please provide additional justification for companies to consider during the Intermediate Round.

– Define relevant DM-RS config [RAN1]

– Define relevant CSI aging mitigation [RAN1]

– Investigate means to mitigate packet interruption due to low DL/UL SNR and beam/cell switching for NTN [RAN2, RAN1]

Feedback Form 18: Coverage enhancements

1 – MediaTek Inc.

We are generally supportive of moderator proposal.

It should be clarified that the low-rate codec for VoNR will re-use legacy 3GPP voice codecs (i.e. AMR, ..). We cannot support the introduction of new voice codec, which will have a far reaching impact on NR standards and development. This cannot be justified by a corner case for satellite of very low link budget at low elevation angles depending on satellite parameter dimensioning. For this objective to be included in Rel-18, there should be assumption that the lowest data rates in specified voice codecs are re-used and no new voice codec will be in scope of discussions (e.g. AMR 4.75 kbit/s).

2 – ZTE Corporation

For this topic, it seems that evaluation to identify the issues are needed and we can start with the SI phase with the following objective only:

- Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN [RAN1]

Regarding other potential solutions, it can be discussed during the WG meeting up to companies' inputs and there is no need to list them in the objectives.

To further reduce the potential workload, we can try to consolidate the interesting scenario (GEO or LEO-600), channel (e.g., PUSCH), and target service for coverage performance evaluation.

3 – Apple AB

We think the current set of objectives for coverage enhancement is fine.

- After the "evaluation of coverage performance", we should know which channels have coverage issues and what is the link budget gap. Then we can discuss detailed objectives including potential solutions. Coverage enhancement for RedCap devices may also be considered.
- Re "reducing RAN protocol overhead for VoNR", the scope is unclear to us as R17 VoNR is already pretty optimized. We are also not sure this effort needs to pursued under the NTN umbrella.

4 – Classon Consulting

for FUTUREWEI Still looks very big. Suggest focus only on the evaluation and study of repetition and (perhaps) the diversity techniques. The objectives should be study and if agreed specify.

5 – Ligado Networks

Agree with Futurewei above, focus on repetitions and diversity. These offer the largest gain for least work in our view.

6 – Spreadtrum Communications

We share the similar views with ZTE. We should first evaluate the coverage performance in NTN, and then identify which channels have coverage issues.

7 – Lockheed Martin

We support the topic of ”Improve the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead for VoNR”

8 – InterDigital

In general support Moderator’s proposal with understanding that candidate set of NTN-specific objectives can be updated/refined based on outcome of evaluation phase.

9 – DOCOMO Communications Lab.

We have same view with ZTE/Spreadtrum. Only the following bullet is sufficient.

- Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN [RAN1]

What is specified should be discussed/identified in this study phase and corresponding plenary meeting. No need to list them now.

10 – China Mobile Group Device Co.

Support the updated objectives.

11 – Qualcomm Incorporated

It’s desirable to clarify item 2 as the following

Study and specify NTN-specific techniques for improved diversity and/or reduced polarization loss [RAN1]

Regarding the low-rate codec, the objective of the RAN work will not be to introduce a new codec (we agree with MTK), but to optimize the RAN to work with the lowest rate codec currently available.

12 – Asia Pacific Telecom co. Ltd

1. Firstly, we support to [evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN], which should be leaded by RAN1 WG. In addition, we suggest to decide the UE types (e.g., a normal UE/RedCap UE) we should consider in the evaluation.

2. Then, [repetitions enhancements] would be discussed based on 3GPP achievements on Rel-17 CovEnh WI.

3. However, the [NTN-specific diversity techniques] are blur and we wonder whether both RAN1/RAN2 WG would involve in this item.

4. For [CSI aging], there is no solid evidence during SI/WI can be found to support whether it is an essential issue.

5. For [relevant DM-RS], current configuration can provide sufficient synchronization accuracy. It is unclear whether further enhancement is needed.

13 – LG Electronics Inc.

We tend to agree with ZTE. We can focus only on the following SI objective:

- Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN [RAN1]

The target scenario and channels for evaluation can be determined via evaluation methodology discussion.

14 – Samsung Electronics Co.

We support this topics to study. More realistic assumptions on the antenna gain as -5 dBi looks good. Some detailed objectives such as ”improve the performance of low-rate codecs..” and the last three objectives (DMRS, CSI, mitigation of packet interruption) need to be more clarified.

- ”Define relevant DM-RS config” is not clear.
- There is no issue on ”beam/cell switching” for NTN.
- In summary, whether there is NTN-specific issues or not should be studied first.

15 – Beijing Xiaomi Mobile Software

We are generally fine with the moderator’s view. However, regarding the “Improve the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead for VoNR [RAN1, RAN2] [Liaise with SA2/SA4 as necessary]”, more clarification is needed on what is the “low-rate codecs”, and what is the RAN1 impact.

16 – THALES

The first set of objectives proposed by the moderator are agreeable.

The second set of objectives can be de prioritized

17 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We think both repetition and diversity enhancements can be prioritized for coverage enhancement in NR NTN with NTN specific issues. Additionally, we also think CSI aging is a critical issue in NR NTN due to large propagation delay, and we prefer some mechanism to solve the issue in addition to implementation based solution.

18 – ESA

We support the evaluation phase and the first set of objectives as described by the moderator.

19 – CATT

1□For the listed feature:

Not sure what means NTN specific diversity techniques? Are there any concrete examples or justifications?

2□For the additional feature:

Due to some prior information of satellite moving, beam switching in low SNR can be enhanced with assisted information. And the beam switching in LEO is very frequent and rather weak in low SNR, so the motivation of improving beam switch in low SNR is clear.

20 – Ericsson LM

We are still of the opinion that all coverage enhancements should be handled in the CovEnh WI, to avoid forking different "flavors" for different scenarios with unintended consequences and waste of effort. In general, wording like "study and specify" suggests that the specific features have been already identified as justified, which does not seem to be the case. At least "study and, if justified by the study, specify" should be written in order not to pre-empt the study.

21 – NOVAMINT

We are generally supportive of the moderator proposal on the 1st objective set.

22 – Intel Corporation SAS

In our view the proposed set of objectives for NR NTN coverage enhancements should be considered in Rel-18 to make sure that smartphone UEs with <0 dBi antenna gain are supported.

Regarding list of objectives for further justification

· It is not clear if where is any coverage gain from decreased DMRS density in frequency domain. In LoS channel DMRS power boosting has equivalent performance comparing to increased number of DMRS REs. If we add more PDSCH RE instead of DMRS it would lead to decreased channel estimation error which has negative impact on coverage. There were extensive studies on DMRS optimization in Rel-17 coverage enhancement WI, but no consensus was reached. We do not see the need to further optimize DMRS configuration for coverage enhancement.

· For CSI aging issue, we suggest to focus on coverage issue without CSI enhancements in this release.

· The objective related to packet interruption is more related to mobility issue, but not to a coverage issue. They can be moved to mobility sub-feature for further consideration.

23 – Sony Europe B.V.

It would be useful to clarify intentions on "improve the performance of low-rate codecs."

24 – HUGHES Network Systems Ltd

We support of the moderator proposal on the 1st objective set.

25 – Rakuten Mobile

We are fine with proposed 1st objective, however 2nd objective can be prioritize.

26 – HUAWEI TECHNOLOGIES Co. Ltd.

We support the moderator proposal to start this activity with evaluation. **For the candidate objectives, we support the first two (repetition enhancements and diversity techniques). For the third candidate objective, we have concerns on its feasibility and potential gain.** We observed that, in the initial round discussion, there are some other companies (DOCOMO□Nokia etc) also question the motivation and potential gain of RAN protocol overhead reduction. Our analysis are provided below:

- PDCP-ROHC: 3Byte (Length of compressed TCP/IP header and the length is variable). ROHC is not defined in 3GPP and we fail to see how it can be further reduced for NTN applications. .

- PDCP header: 2Byte (including the PDCP SN). It cannot be reduced because both deciphering and in order delivery need the PDCP SN.

- RLC: 1Byte for UM (Unacknowledged Mode) mode. This one byte *can possibly be reduced* if TM (Transparent Mode) mode is introduced and used. . However, if TM is used, it actually removes RLC layer and makes the scheduling less flexible and less efficient as segmentation/resembling is excluded.

- MAC: 2Byte (including the 6 bit LCH ID, 1 Byte Length and 1 bit Format field, and 1 bit Reserved bit). It cannot be reduced because :1) there are other LCHs as well as MAC CEs for this UE, so the LCH ID is needed for differentiation. 2) The size of MAC SDU is not fixed due to the SID frame, variable frame rate and variable ROHC header, the length field is also needed.

-

Therefore, we only see 1 byte room for protocol overhead reduction, which is around 5% for AMR 4.75 kbps. And this 1 byte RLC overhead reduction will, on the other hand, make the scheduling less flexible and less efficient as segmentation/reassembling is excluded. So we did not see the feasibility and potential gain for this objective of RAN protocol overhead reduction and our view is not to include this objective for Rel-18 NTN.

We support not to include the candidate objectives that requires additional justification, e.g. DM-RS, CSI aging and packet interruption.

27 – NEC Telecom MODUS Ltd.

we are fine with the moderator's proposals

28 – Gatehouse Satcom A/S

We generally support the moderator's proposal on the first set of objectives.

29 – HISPASAT SA

We are supportive of moderator's proposals.

30 – Fraunhofer IIS

We agree with the general scope of the coverage enhancement especially focusing on the techniques that are beyond Rel-17 CoVEnh WI. Regarding the candidate objectives, for the first bullet (Define relevant DM-RS config [RAN1]), the objective can be set to reduce the overhead, given the LOS channel in NTN and low mobility UEs (VSAT terminals). We recommend the following text proposal regarding clarifying the scope of DM-RS configuration:

· Identify and specify the solution to reduce the DM-RS density for NTN scenarios

We emphasize that we do not support any down-selection of the list of objectives in this meeting. All identified objectives must be included, especially if the first step is to evaluate the coverage performance and identify the candidate channels. We prefer to have all potential solutions for coverage enhancements for the identified channels.

2.1.1.2 NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE

Leading WG = RAN4, Secondary WG = RAN1

Potential interaction with SA/CT: None

The following assumptions are taken a baseline for this work:

- GEO and NGSO (e.g. LEO, MEO, HEO) based satellite access to be considered
- Targeted UE types: fixed and mobile VSAT. VSAT/ESIM UE characteristics from TR38.821 to be considered in priority but additional NTN UE classes may be considered
- FDD mode is assumed for satellite operation above 10 GHz, while TDD mode is assumed for terrestrial operation in FR2
- The harmonized Ka band frequency range (17.7-20.2 and 27.5-30.0) as common across all regions will serve as reference

As agreed in RP-211658, introduction of new bands beyond those identified in the initial WI would be handled in a release-independent manner and would follow the normal RAN4 spectrum-related WI process for introduction of new bands. Some modifications to the proposed list of objectives provided in the Initial Round were made based on company input. Any modifications were also compared to the approved way forward in RP-211596 to ensure that they were inline.

- Study and identify NTN bands: Analysis of regulations and adjacent channel co-existence and future-proof protection of TN [RAN4]
    - Consider at least a portion of the Ka band as the example band, according to ITU allocation; identify which parts of the Ka band are suitable as 3GPP bands [RAN4]
    - Study implications of FDD operation in FR2 and derive requirements appropriately. Satellite bands introduced in 3GPP for NTN for FDD shall not impact the existing 3GPP TDD specifications for terrestrial bands (see note 3 of the approved way forward RP-211596 in RAN#92-e). [RAN4]
    - Relevant coexistence scenarios and analysis to be considered in RAN4, if and where applicable, to ensure there is no interference of NTN toward TN [RAN4]
    - Definition of NTN band(s) above 10 GHz does not change the current FR1/FR2 definition, nor automatically apply to future terrestrial bands defined in this frequency region; (see proposal 3 of the approved way forward RP-211596 in RAN#92-e) [RAN4]
- Specify Rx/Tx requirements for different VSAT/ESIM UE class (not only 60 cm aperture) [RAN4]
- Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed [RAN4]
- Specify the RRM requirements [RAN4]

    - Identify and specify impacts to beam management requirements for VSAT UE class

- Specify the conformance testing [RAN4]
- Specify physical layer parameters such as time relationship related enhancement (K_offset), subcarrier spacing for different UL/DL signals/channels, PRACH configuration index for FDD above 10 GHz. Maximum reuse of existing L1 parameters and design should be made. Introduction of new SCSs on top of already defined values is not in scope. [RAN1,RAN4]

The following objective was removed for now in favor of a RAN4-specific task in the RRM requirements section. If the intention is to specify physical layer features/enhancements, proponents should provide a more detailed description of the corresponding features/enhancements which are to be considered during the Intermediate Round.

- Specify beam management and BWP operation/switching in NTN considering the characteristics of satellite beams (e.g., large beam footprint, multiple beams per satellite, and FDD for FR2) [RAN4]

Feedback Form 19: NR-NTN deployment in above 10 GHz bands

1 – MediaTek Inc. We support moderator proposal
2 – ZTE Corporation We are fine to this proposal and for the RAN4 work, we may need to conclude the example band.
3 – Apple AB For the last bullet, we suggest removing K_offset since timing relationship enhancements need not be restricted to k_offset only.
4 – Classon Consulting for FUTUREWEI Support
5 – Spreadtrum Communications We support moderator proposal
6 – InterDigital In general supportive of Moderator proposal.
7 – China Mobile Group Device Co. We are fine with the objectives suggested by the moderator.
8 – Qualcomm Incorporated We are fine with the proposed objectives.

9 – Asia Pacific Telecom co. Ltd

We support the objectives. thanks

10 – Samsung Electronics Co.

We support this topic for Rel-18.

11 – Beijing Xiaomi Mobile Software

We generally support the moderator proposal. Regarding to RF requirements, we think satellite BS should also be involved. Thus, for the item "Specify Rx/Tx requirements for different VSAT/ESIM UE class", it is proposed to be changed as "Specify Rx/Tx requirements for satellite BS and different VSAT/ESIM UE class (not only 60 cm aperture).

12 – Panasonic Corporation

We support moderator proposal.

13 – THALES

1/ We do agree to the assumptions

2/ In general, the 1st proposed set of objectives from moderator are agreeable.

However we suggest to correct the below bullet points as follow:

«- Study and identify NTN bands: Analysis of regulations and ***relevant*** *adjacent channel co-existence ~~and future-proof protection of TN~~* ***to ensure no impact on existing 3GPP TDD specifications for terrestrial bands*** *[RAN4] » => Unclear what "Future-proof protection of TN" means in technical terms. Need to align with wording in note 3 of the approved way forward RP-211596 in RAN#92-e.*

« ○ Relevant coexistence scenarios and analysis to be considered in RAN4, if and where applicable, to ensure there is no ~~interference of NTN toward TN~~ ***impact on existing 3GPP TDD specifications for terrestrial bands*** *[RAN4] » => Need to align with wording in note 3 of the approved way forward RP-211596 in RAN#92-e.*

3/ The second set of objectives can be de prioritized.

14 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine to study some physical layer parameters to support FDD above 10GHz. Additionally, we also prefer beam management and BWP operation/switching to be support in R18. The reason is that by FRF>1 we can improve the spectral efficiency with low latency. And R17 solution based on existing NR specification may lead to high latency and large signaling overhead.

15 – ESA

We support the moderator's text with the changes proposed by Thales

16 – CATT

Agree the moderator observation.

17 – Ericsson LM

On UE types, no preclusion on looking into additional NTN UE classes, but it should be based on justification (and TR 38.821 shall always be considered as the basis). So, we propose to reword the relevant bullet as "… UE characteristics from TR 38.821 to be considered as basis, but additional NTN UE classes may be considered if justified." A bullet "RAN4 to take a look at the NTN bands above 10GHz and decide which "FR" properties they should be based upon, and make the requirements based on this." Should be added (RP-211596). Regarding the bullet "Specify Rx/Tx requirements for different VSAT/ESIM UE class (not only 60 cm aperture) [RAN4]" we should add "as appropriate for the identified example band".

18 – NOVAMINT

We support the changes proposed by Thales on the text

19 – Intel Corporation SAS

1) For "Specify Rx/Tx requirements …" – the objective shall cover both BS and UE RF requirements and can be rephrased as "Specify BS and UE RF requirements"

2) For "Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed" – this can be a part of RRM requirements discussion, and we do not see value in a separate bullet

3) Conformance testing is limited to BS side. Overall, the objectives shall cover Core and Performance part and additional performance part objectives can be formulated as

· *Performance requirements*

o *Specify RRM performance requirements and test cases [RAN4]*

o *Specify UE demodulation and CSI reporting requirements [RAN4]*

o *Specify BS demodulation requirements [RAN4]*

o *Specify BS conformance tests [RAN4]*

For the last bullet we suggest the following wording. The initial wording is misleading, someone may think that new PRACH configuration index or new values for K_offset are in scope which is not the case in our understanding.

· ~~Specify~~ Identify values for physical layer parameters such as time relationship related enhancement (K_offset), subcarrier spacing for different UL/DL signals/channels, PRACH configuration index for FDD above 10 GHz. ~~Maximum reuse of existing L1 parameters and design should be made.~~ Introduction of new ~~SCSs~~ values for physical layer parameters on top of already defined values is not in scope. [RAN1,RAN4]

Regarding the beam management and BWP operation, we agree with the moderator's recommendation to remove this objective.

Also, we would like to acknowledge again that NTN work in Rel-18 may have a potentially large scope in RAN4 including NR-NTN deployment in above 10 GHz and requirements for new Rel-18 features. Further prioritization of work can be required taking into account available RAN4 TU capacity.

20 – Nokia France

Note that this objective requires an enormous amount of work in RAN4, and substantial TUs would have to be allocated in RAN4 for this work.

The bullet ”Study implications of FDD operation in FR2 and derive requirements appropriately” should be explicitly limited to the Ka band in order to control the scope.

One clarification is needed in the RAN1/4 objective: Introduction of new SCSs for a given signal/channel on top of already defined values is not in scope.

21 – HUGHES Network Systems Ltd

We agree with moderator that some of this work is already confirmed to start in RAN4 after March 2022 and considering Ka band as candidate example band once FR1 NTN coexistence study is stable enough per RAN#92-e agreement in RP-211596.

We agree with moderator’s recommendation is to focus the initial work on the general issues of NTN operation with TDD bands and FDD in FR2 and the handling of 7-24GHz bands.

As for the objectives we support changes proposed by Thales.

22 – HUAWEI TECHNOLOGIES Co. Ltd.

We are generally support NR NTN in above 10 GHz band. We have below detailed suggestion:

On the second bullet of the assumption part and the objective part, it is confusing to list VSAT/ESIM for UE types and it not correct to say “VSAT/ESIM UE characteristics from TR38.821”. In TR38.821 and Rel-17 NR NTN WID, VSAT and handheld are both discussed and included, while ESIM, as a terminal type, has not be discussed/mentioned in 38.821 and Rel-17 NR NTN WID. According ITU (https://www.itu.int/en/mediacentre/back stations-in-motion-satellite-issues.aspx), “Earth stations in motion (ESIM) are earth stations that communicate with geostationary-satellite orbit (GSO) systems operating in the fixed-satellite service (FSS) and operate on platforms in motion in the frequency ranges 17.7-20.2 GHz (space-to-Earth) and 27.5-30 GHz (Earth-to-space).” So ESIM and VSAT are defined from different aspects. According to our understanding some VSAT device can support ESIM services. It is not clear to us what does the term “VSAT/ESIM” mean. To avoid confusion, we suggest to remove ESIM and only keep VSAT, i.e. VSAT/~~ESIM~~.

23 – Gatehouse Satcom A/S

We support the moderator’s view, though with taking in account the more clear descriptions of Thales on “Study and identify NTN bands” and “..coexistence scenarios and analysis..”.

24 – HISPASAT SA

We generally agree on moderator’s proposal, and we support changes proposed by Thales.

25 – Fraunhofer IIS

We are generally fine with the list of objectives mentioned by the moderator.

26 – Eutelsat S.A.

We support the changes proposed by Thales.

2.1.1.3 NTN-TN and NTN-NTN mobility and service continuity enhancements

Leading WG = RAN2, Secondary WG = RAN1, RAN4-RD (RRM)

Potential interaction with SA/CT: None

Consider existing methods from NR TN as baseline for NTN-TN mobility as well as Rel-17 WI outcome and further mobility enhancements for NTN-NTN can be considered if new issues are identified in Rel-18. In addition, discontinuous coverage scenario may also be considered in service continuity enhancements and may take solutions developed in Rel-17 IoT NTN as a baseline. Based on the outcome, the following list would be used as a starting point and further refined based on the gaps for NTN-TN and NTN-NTN.

Please provide more detail concerning the following items as expressed by companies looking for further clarification/understanding. It should be clarified what is not already covered by CHO or by existing procedures as well as expected use cases. Please add your views and any specific actionable objectives as sub-bullets so that the work for each objective can be focused.

- Address handover interruption, handover signalling overhead and RACH congestion [RAN2,RAN1]
- Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements for different delay and/or network topology between the different access types/points/nodes [RAN2,RAN4-RD (RRM),RAN1?]
- Address RLF reduction issue for different delay and/or network topology between the different access types/points/nodes [RAN2, RAN1?]

The following additional set of objectives were also proposed during the initial round. Some of these objectives rely on other controversial topics. Please provide your viewpoints if they should be considered at this time.

- Enhancement to Xn/NG to exchange the necessary information between TN and NTN gNBs (e.g. RAT type of each serving cell) [RAN3]
- Specify the support of enhanced schemes such as the DAPS to guarantee the service continuity [RAN2]
- Address group handover configuration and procedure (enhancements?) [RAN2]
- UE location-based refusal of service [RAN2, RAN3]

Given that the following option concerning a possible service continuity enhancement was in brackets in RP-211658 and that there is no consensus on this option, it will need additional justification if it is to be included in the initial list of candidate objectives. Please provide additional justification for companies to consider during the Intermediate Round.

- Evaluation of multi-connectivity for NTN as one possible service continuity enhancement [RAN1, RAN2]

Feedback Form 20: NTN-TN and NTN-NTN mobility and service continuity enhancements

1 – MediaTek Inc.

We are generally supportive of moderator proposal.

We do not see any particular issue with RACH congestion. This can be de-prioritized.

2 – ZTE Corporation

We are generally supportive of the 1st objective.

3 – Apple AB

We believe that the ongoing and planned activity on discontinuous coverage in IoT NTN is also useful for NR NTN. We propose adding adding a separate bullet for supporting discontinuous coverage using IoT NTN work as baseline.

4 – Classon Consulting

for FUTUREWEI Still a bit big and unclear, if included after clarification, should be a study first.

5 – Ligado Networks

We support the moderator proposal.

6 – InterDigital

In general supportive of Moderator proposal, however we do still see some benefit in enhanced schemes such as DAPS. Since there wasn't consensus in initial round a dedicated objective may not be agreeable, but as a compromise we think it should not be precluded from consideration to satisfy core objectives (i.e. the first three bullets)

7 – DOCOMO Communications Lab.

We are fine with the 1st objective set.

8 – China Mobile Group Device Co.

Agree with the objectives provided by the moderator.

9 – Qualcomm Incorporated

We think the first three bullets are sufficient in this item. We can simplify the second bullet as "Specify NTN-TN and NTN-NTN service continuity enhancements". Our view on multi-connectivity is the same. UE location-based refusal has a lot of implications, for example, SA2 has to allow RAN can do this and SA3 has to find a solution to avoid attack, and we do not see good justification for this enhancement.

10 – Asia Pacific Telecom co. Ltd

1. Agree the first three bullets except RACH congestion.
It seems RAN2 WG has evaluated the RACH capacity and no issue has been found.

2. For RLF issue, we suggest to include RAN1 WG to clarify possible impacts from PHY layer.

11 – LG Electronics Inc.

We agree with 1st objectives and the last objective – "Evaluation of multi-connectivity for NTN as one possible service continuity enhancement." Multi connectivity in NTN is also on the table in Rel-18 NTN, and we believe that the multi connection can increase robustness of service continuity.

12 – Samsung Electronics Co.

We support this issue to be handled in Rel-18.

13 – Beijing Xiaomi Mobile Software

The location based and timing based CHO introduced in Rel-17 can reduce the handover interruption to a certain degree, but there is still interruption, so DAPS can be considered. For the quasi earth fixed cell, the handover signaling overhead and RACH congestion should be addressed since there are a lot of UE need to perform handover and RACH procedure simultaneously.

For the multi-connectivity for NTN, we think the multi-connectivity between GEO and LEO can be considered, GEO provides coverage and LEO provides throughput, and the handover probability will be reduced.

For RLF reduction issues, we think some solutions can be studied for reducing RLF.

14 – THALES

The first proposed set of objectives from moderator are agreeable.

If possible, we would like to also add

- Specify the support of enhanced schemes such as the DAPS to guarantee the service continuity [RAN2]

- Address group handover configuration and procedure (enhancements?) [RAN2]

Last we suggest that the NTN-NTN multi connectivity topic be also considered.

15 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are supportive of mobility enhancements listed in the first set.

We think "□ Specify the support of enhanced schemes such as the DAPS to guarantee the service continuity [RAN2]" can be a subset included in "□ Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements for different delay and/or network topology between the different access types/points/nodes [RAN2, RAN4-RD (RRM), RAN1?]".

For "□ Evaluation of multi-connectivity for NTN as one possible service continuity enhancement [RAN1, RAN2]", support of DC or multi-connectivity in NTN was deprioritized in Rel-17 due to limited time budget. In Rel-18 we would like to consider at least DC between NTN and TN, wherein the advantage of NTN coverage can provide effective supplements for TN, while TN can cover the shortage of large propagation delay e.g. for some time-sensitive services. With such support the service continuity between NTN and TN can be better guaranteed.

16 – CATT

"Enhancement to Xn/NG to exchange the necessary information between TN and NTN gNBs (e.g. RAT type of each serving cell) [RAN3]"could be **merged to** "Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements for different delay and/or network topology between the different access types/points/nodes [RAN2,RAN4-RD (RRM),RAN1?]"

- Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements for different delay and/or network topology between the different access types/points/nodes [RAN2,RAN4-RD (RRM),RAN1?, **RAN3**]

Another important thing to be considered in Rel-18:

During the NR NTN Rel-17 discussion in RAN3, we discussed how to exchange necessary info between gNBs (e.g. served cell info) to support feeder link switch, and agreed only to adopt OAM based solution in Rel-17. This brings extra complexity to OAM, the signalling based solution should be further worked in Rel-18. Thus, we propose to add one objective:

- **Enhancement to Xn/NG to exchange the necessary information between NTN gNBs for feeder link switch. [RAN3]**

Due to the limit of time for Rel-18, the other objectives, e.g. group handover, DAPS, multi-connectivity, if needed, could be considered in the future release.

17 – Ericsson LM

In general, this seems agreeable, although we have to note that descriptions are still very open-ended. We should try to identify more precisely the enhancements we are envisaging and add "if justified" – a number of enhancements were already discussed for Rel-17 and received no consensus. We should not continue discussing those. We would suggest to reword the RLF reduction bullet as "Consider RLF reduction issue for …" and add "if justified". As a general note, regenerative architecture with full gNB onboard is an enabler for enhanced mobility. As it can reduce the need for new solutions it would seem beneficial to consider as baseline for mobility enhancements. As network interfaces were already enhanced with RAT type of serving cell according to SA2 agreements during Rel-17, no further enhancement seems to be needed on this respect. Furthermore, it was already shown in the SI that Xn between TN and NTN was not feasible, regardless of the NTN architecture. Therefore, the corresponding bullet should be removed. Same goes for UE location-based refusal of service: RAN2, RAN3 and SA2 are addressing this in Rel-17, so it should be removed unless clearly anchored in a new SA2 requirement (which we don't see yet). Group HO configuration is currently being discussed in Rel-17 IAB, so it's not something essential to NTN – we should first wait for it to stabilize, then perhaps it could be studied applied to NTN. And as we already explained, multi-connectivity seems premature – we should not pursue it at this time.

18 – NOVAMINT

We are generally supportive of the moderator proposal on the 1st objective set.

19 – Intel Corporation SAS

First group:

· Address handover interruption, handover signalling overhead and RACH congestion [RAN2,RAN1]

[Intel] We are OK with this bullet.

· Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements for different delay and/or network topology between the different access types/points/nodes [RAN2,RAN4-RD (RRM),RAN1?]

[Intel] If this bullet means to cover all potential use cases, we could remove "for different delay and/or network topology between the different access types/points/nodes"

· Address RLF reduction issue for different delay and/or network topology between the different access types/points/nodes [RAN2, RAN1?]

[Intel] It's still not clear what RLF reduction refers, detailed description can be added. If this bullet means to cover all potential use cases, we could remove "for different delay and/or network topology between the different access types/points/nodes"

Second group:

· Enhancement to Xn/NG to exchange the necessary information between TN and NTN gNBs (e.g. RAT type of each serving cell) [RAN3]

[Intel] This bullet can be merged to "service continuity enhancements" by adding RAN3 to the WG list.

· Specify the support of enhanced schemes such as the DAPS to guarantee the service continuity [RAN2]

[Intel] This bullet is included in "Address handover interruption" bullet in fact, so no need to repeat.

· Address group handover configuration and procedure (enhancements?) [RAN2]

[Intel] This is candidate solution for "handover signalling overhead and RACH congestion", and it can be put under this bullet if needed.

· UE location-based refusal of service [RAN2, RAN3]

[Intel] Not clear about the benefit

Third Group:

· Evaluation of multi-connectivity for NTN as one possible service continuity enhancement [RAN1, RAN2]

[Intel] Current understanding is to support TN prioritization over NTN. So we are not convinced to support DC-like enhancements for service continuity.

20 – Sony Europe B.V.

We are in general ok with the moderator proposals. We provide supporting information for a few of them along with some clarifications:

Regarding, Address handover interruption, handover signalling overhead and RACH congestion:

We think that HO signalling overheads will be large in a LEO deployment where a HO will take place for every UE effectively every few seconds. This should have ideally been addressed in Rel-17.

We think RACH congestion is not an issue but RACH-less HO should be supported to avoid the delay during HO and probably UE maintaining the sync, so "RACH congestion" should be reworded to "RACH-less HO".

On UE location-based refusal of service [RAN2, RAN3]

This objective can be met in Rel-17 if the accuracy of UE location reporting while in connected mode and during initial access is of finer granularity (finer than 2kms as currently agreed in RAN2). If Rel-17 does not allow UE location reporting on finer granularity then methods and details should be discussed in Rel-18.

21 – CEWiT

We are fine with primary objective. Secondary objectives are less priority.

22 – HUGHES Network Systems Ltd

We support moderator's proposal.

23 – Nokia France

The first set of objectives seem reasonable, except that "RLF reduction issue" is still not clear - if this can't be clarified it should be removed.

24 – Rakuten Mobile

We are in general ok with the moderator proposals.

25 – Rakuten Mobile

.

26 – NEC Telecom MODUS Ltd.

we are in general supportive of the moderator's summary and proposals.

it is our understanding that most of the items in the second set of objectives could already be covered by the first set of objectives, e.g. DAPS can be discussed as one candidate solution to address handover interruption, group handover can be discussed as one candidate solution to address handover signalling overhead.

We also suggest to add RAN3 as secondary WG since enhancement to Xn/NG interface may be necessary.

27 – HUAWEI TECHNOLOGIES Co. Ltd.

For the first set of objectives, we have question regarding RACH congestion. RAN2 WG has discussed the RACH congestion in case of group HO but fond CFRA could mitigate the issue□R2#107bis_R2-1913604□. For other cases, we don't think there will be RACH congestion in RAN2. It is unclear to use why there is a need to reopen RACH congestion discussion.

For the second and third set of objectives, we fail to see the justification, so we prefer not to include these potential objectives this time.

28 – Gatehouse Satcom A/S

We generally support the moderator's proposal on the first set of objectives.

29 – HISPASAT SA

We support moderator's proposal.

30 – Fraunhofer IIS

We are generally fine with the list of objectives mentioned by the moderator.

2.1.1.4 Network based UE location

Leading WG = RAN1, Secondary WG = RAN2, RAN3

Potential interaction with SA/CT: SA2, SA3 and SA3-LI with respect to 'Network verified UE location' and 'UE independence of GNSS' and their possible impact on regulatory requirements (e.g. LI, PWS, ...)

The moderator recommends starting this topic in Rel-18 with a study item to determine how the network can determine the UE location without relying on UE GNSS measurements. Further discussion needs to occur at RAN#94-e concerning the priority level and handling of the work in Rel-18 and if it should be treated in the Evolution of NR NTN area or in the Positioning Enhancements area to involve positioning experts given the differing company views on this matter. Any applicability to NTN IoT could also be considered. Non-GNSS capable UE aspects are not considered in this topic and were taken in the Others section.

Objectives shall initially focus on the applicability of existing positioning solutions to NTN, and identify potential issues and enhancements if necessary, considering the NTN characteristics including large propagation delay and satellite movement.

The moderator would like input on the additional proposed study item objectives below which were developed from company feedback during the Initial Round focusing on the objectives of a Study Item.

- Study network-based positioning solutions suitable for NTN considering security and regulation requirements [RAN1,RAN2]
- Study possible architectural enhancements for NTN positioning network [RAN3, RAN2]
- Study and evaluate solutions for network to verify UE reported location information [RAN1,RAN2]
- Study UE positioning techniques with the assumption that the number of satellites in view is limited (including single satellite) [RAN1]
- Study possible issues of applying existing network-based positioning solutions in NTN, and specify enhancements (RS design, measurement reporting, etc.) if any. [RAN1,RAN2,RAN3]

In addition, the following list of objectives for the study was provided by Thales and supported by many companies. Some of these objectives could also apply to a work item. Please provide your input concerning which items should be addressed during the study phase versus any follow-on work item phase.

- Evaluate the existing positioning methods applicable to UE connected via an NTN network [RAN1]
- Identify and specify any enhancements necessary to support LCS in NTN networks using existing methods, or if necessary, specify a new positioning method applicable to NTN network [RAN1,RAN2]
- Enhancements may include additional measurement information to be reported by the UE to the LMF, additional information provided by the gNB to the LMF. Periodicity and accuracy of these information will have to be discussed [RAN1]

- Identify the performance achievable in NTN network (i.e. accuracy of the UE location) [RAN1]
- Signalling overhead and efficiency impact [RAN2]
- Signalling between gNB and LMF (e.g. reporting of satellite ephemeris) [RAN3]

Feedback Form 21: Network based UE location

1 – MediaTek Inc.

We are generally supportive of a study. The scope of the study for network to verify UE reported location information could be reduced by re-using Rel-17 UE-specific Timing Advance report as baseline. We see this as the simplest way to very UE location report and minimize impact on specifications in RAN1.

2 – MediaTek Inc.

The issue is not leveraging the Redcap feature. HD-FDD for NTN UE with existing NR specs need to be specified. This was not addressed in NR NTN. It was shown in Rel-17 IoT NTN, that support of HD FDD operations in legacy NB-IoT / eMTC required enhancements to be specified in RAN1 and RAN2. We expect that there will be need to specify some enhancements to support HD-FDD in NR NTN. **This is separate discussions from Redcap feature, which do not include NTN-specific enhancements to support HD FDD.**

3 – ZTE Corporation

Regarding the network positioning issue, considering the workload, it should be the SI in Rel-18 only to evaluate the performance/applicability of legacy network-based positioning for the regulation issue in NTN-specific scenarios.

In addition, the assumption on UE's capability of GNSS should be kept and no further enhancement on the synchronization procedure compared to the Rel-17 is needed.

4 – Classon Consulting

for FUTUREWEI Low priority, and if study to be done it should be in positioning and not here.

Having two sets of objectives doesn't help to converge to what is the most important.

5 – Ligado Networks

We agree with MediaTek's comments above.

6 – InterDigital

In general supportive of Moderator proposal from an NTN perspective, but objectives to be confirmed and further refined with positioning experts. One aspect we think should be carefully evaluated is impact of latency on positioning techniques.

7 – DOCOMO Communications Lab.

We can be flexible to study NTN pos in Rel-18, but the study should be done in positioning SI/WI. Not NTN part. Note that SL pos / RedCap pos are discussed in positioning SI/WI. Quite unclear why NTN pos is discussed here.

For study item objectives, only evaluation on applicability/issues of legacy positioning mechanism is sufficient first. After that, SID/WID can be updated based on the outcome. No need to list details on solution perspective here.

8 – China Mobile Group Device Co.

Considering the limited TUs, starting this topic as a SI in R18 may be better.

9 – Qualcomm Incorporated

We are in principle fine with the proposed study item objectives. Item 1 and 3 can be merged into 1 as

Study network-based positioning solutions suitable for NTN and identify achievable performance considering [RAN1, RAN2]

- limited satellites including a single satellite
- security /regulation requirements
- use of positioning measurements obtained by a UE, gNB(s) or both

10 – Asia Pacific Telecom co. Ltd

1. We are open to discuss this topic in Rel-18. However, we have doubts about the loading of this topic.
2. We suggest to start this topic from a SI.

11 – LG Electronics Inc.

We still believe this SI should belong to positioning WI (not here).

12 – Samsung Electronics Co.

We are open to discuss but prefer to take it as the 2nd priority.

13 – Beijing Xiaomi Mobile Software

We want to have the moderator's clarification on it is a separate study item or it is a study phase within the eNTN WI. Our preference is to include this topic in eNTN rather than in positioning WI as the different requirements/techniques are expected compared to the positioning in TN and positioning WI is already crowded. Before we dive into the solutions, we think it is better to have a study phase to have common understanding on the accuracy requirement and other related issues.

14 – THALES

The first proposed set of objectives from moderator are agreeable. Note that the work could be restricted considering "network verified UE location" and the assumption of re-using existing physical channel design with minimum adjustments if found beneficial.

15 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are generally supportive of high priority for NTN positioning in Rel-18. We are also fine with the objective proposed by Thales. We think there may be some overlap between the objective per company's feedback and the objective proposed by Thales, so some kind of merge may be necessary. Although PRS

may be configured for RRC connected UE, we think similar solutions should also be considered for RRC idle UE to determine TA for preamble transmission.

16 – Lenovo (Beijing) Ltd

We still prefer to consider the following topics for NR NTN.

- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Regenerative Payload with Inter-Satellite Link (ISL)
- Enhanced beam management

17 – THALES

This "network verified UE location" feature is needed to support regulated services/features such as Public Warning System, Charging and Billing, Emergency calls, Lawful Intercept, Data Retention Policy in cross-border scenarios and international regions, Network access. This requires non terrestrial networks to have the capability to locate each UE with comparable accuracy and reliability to terrestrial networks. SA3-LI notes that any method which relies solely on UE-generated location information is unlikely to be considered "reliable" (See S3i210282)

18 – ESA

The need for "Network based (verified) UE location" is an important aspect as highlighted by SA3-LI. It is fine to start with a study item based on the first set of objectives identified by the moderator.

19 – CATT

Starting a SI would be preferred. The following points are premature to go to WI without clear justifications:

−Identify and specify any enhancements necessary to support LCS in NTN networks using existingmethods, or if necessary, specify a new positioning method applicable to NTN network[RAN1,RAN2]

Enhancements may include additional measurement information to be reported by the UE to the LMF, additional information provided by the gNB to the LMF. Periodicity and accuracy of these information will have to be discussed [RAN1]

− Identify the performance achievable in NTN network (i.e. accuracy of the UE location) [RAN1]

− Signalling overhead and efficiency impact [RAN2]

− Signalling between gNB and LMF (e.g. reporting of satellite ephemeris) [RAN3]

20 – Ericsson LM

The objectives seem agreeable, but we still believe it would be best to handle this issue within the appropriate Positioning WI so the appropriate specialists can look at it. In any case, even if a dedicated SI is agreed, the question we need to address is, are there any requirements that cannot be met by Rel-17 methods, or why should we spend any effort on this in the first place? For this reason, the first priority should be the evaluation of existing positioning methods applicable to this scenario: we should add "As first priority, …" to the corresponding RAN1 objective. The scope of any potential enhancements would depend on the outcome of this activity.

21 – NOVAMINT

Agree with Thales and ESA

22 – Intel Corporation SAS

Objective 1 and objective 4 can be merged as follows.

· Study network-based positioning solutions suitable for NTN considering security and regulation requirements and considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2]

For objective 2, if we stick to transparent payload onboard in R18, we don't think architectural enhancements should be included in this study phase, and the main point should focus on the adaptations of existing positioning methods.

For objective 3, it is not clear what is "UE reported location information". We propose to focus only on network-based positioning for NTN, so reporting of GNSS-based UE location should not be considered.

For objective 5, we suggest to delete "(RS design, measurement reporting, etc.)". At this stage it is not clear which enhancements are needed.

23 – CEWiT

We are fine with the objectives.

24 – HUGHES Network Systems Ltd

We agree with ESA - the need for "Network based (verified) UE location" is an important aspect as highlighted by SA3-LI. It is fine to start with a study item based on the first set of objectives identified by the moderator.

25 – Nokia France

We support the first list of objectives. The second list has considerable overlap with the first, so if they are to be included they need to be properly merged to avoid redundancy and overlap.

26 – NEC Telecom MODUS Ltd.

We are in general supportive to have a SI with the objectives suggested by moderator.

27 – Gatehouse Satcom A/S

Agree with Thales and ESA (and Novamint).

28 – HISPASAT SA

We follow the justification driven by Thales, network location is a necessary feature for those regulatory services.

29 – HUAWEI TECHNOLOGIES Co. Ltd.

We are open to study this area as long as the requirement and the scope are clearly clarified.

In the initial round discussion, some companies pointed out that there is no detailed requirement, while some company mentioned the "all regulatory requirements (lawful intercept, emergency calls, etc.) can be

met already with the Rel-17 solutions". As we commented in the initial round, the only requirement we are aware of is that "SA3LI notes that any method which relies solely on UE-generated location information is unlikely to be considered reliable for network selection purposes. Therefore, a method such as GNSS/A-GNSS cannot be considered as reliable or trusted unless the information provided by the UE can be verified by the network."

From our view:

1. There is no detailed requirement in 3GPP on the accuracy of the location verification, i.e. what is the maximum positioning tolerance under which the network can verify that the information provided by the UE is reliable or trusted.

2. SA3 only asked verification of UE-generated location, and did not require the support of no-GNSS UE. It is unclear whether GNSS should be assumed available on UE or not. This will certainly impact the potential solution.

Before these reqirements can be clarified, I did not see how working group can go with the evaluation.

So we do not support the discussion of too-detailed objective before requirement and scope are clear. May be an agreeable objective could be:

- Study detailed regulatory requirement for network-verified UE location, e.g. accuracy requirement.
- Evaluate performance/applicability of legacy network-based location verification mechanism for NTN-specific scenarios
- Study whether there is gap to meet regulatory requirement and, if needed, potential solutions

30 – Fraunhofer IIS

We agree to go with the majority view on whether to have a study item, followed by a work item based on finding of the study or directly go to work item based, with a study phase at the beginning. We have a slight preference for the second alternative because normative work is required

1. To fulfill the requirement given by SA3-LI (LS from S3i to RAN2, (S3i210282)

2. The existing RAT-dependent positioning methods in LCS need at least some enhancements in signalling aspects, to take into account the differences between terrestrial networks and non-terrestrial networks

3. The SA2 specification 23.273 specifies network-initiated location requests for selecting the correct PLMN in a country. Given that GNSS/A-GNSS is not considered reliable or trusted from S3i perspective, the existing RAT-dependent methods need to be enhanced or a new method needs to be specified.

This implies there is a need for some normative work in RAN1. The study phase within the work item can look into whether the existing methods can be extended or whether a new method needs to be specified. Positioning for NTN-IoT UEs can be left to be out of scope for Rel. 18 and can be addressed in subsequent releases to keep the load manageable for now.

Regarding allocation of work, we are open to both alternatives, whether it is handled within the evolution of NR-NTN or within positioning enhancements. However, if this topic would be handled within the evolution of NR-NTN, it would be beneficial to schedule the work so that there is minimum conflict between time allocation for NTN evolution and positioning enhancements, so that positioning colleagues can contribute to the discussions pertaining to LCS aspects on NTN networks.

2.1.1.5 Other comments for controversial topics identified in RP-211658

As expressed prior to the Initial Round, the topics in this area did not have consensus for further discussion in Rel-18 as presently understood based on the overall Rel-18 workload, priority level when compared to topics above, justification, etc. No further compromise proposals were presented and/or agreed for the following

topics during the Initial Round.

- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Support of MBS
- Regenerative Payload with Inter-Satellite Link (ISL)
- Enhanced beam management
- Study of DL PAPR reduction
- Study of UE without GNSS
- Spectrum re-use/sharing
- HD-FDD capability for NTN UEs by leveraging the RedCap feature

Given that company views have not changed, the moderator suggests stopping further discussion on these topics prior to RAN#94e. If companies would like to continue working towards consensus, proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions to work on possible compromise solutions. Any further views and/or compromise proposals can be provided in the general feedback from provided in the Intermediate Round or taken as company input at RAN#94e.

Feedback Form 22: General feedback for controversial topics identified in RP-211658

1 – MediaTek Inc.

The issue is not leveraging the Redcap feature. HD-FDD for NTN UE with existing NR specs need to be specified. This was not addressed in NR NTN. It was shown in Rel-17 IoT NTN, that support of HD FDD operations in legacy NB-IoT / eMTC required enhancements to be specified in RAN1 and RAN2. We expect that there will be need to specify some enhancements to support HD-FDD in NR NTN. **This is separate discussions from Redcap feature, which do not include NTN-specific enhancements to support HD FDD.**

Sharing of TN spectrum for satellite should be prioritised to address serious satellite spectrum shortage. There is simply not enough satellite spectrum, especially in sub 6 GHz. We see no issue for cellular operators to share their spectrum for satellite in the middle of deserts or territorial waters with spare or non-existent population where anyway cellular spectrum cannot be used to its full potential and is very costly deployment.

We'd propose that Moderator capture that companies commented that MBS can be supported based on Rel-17 NR MBS without enhancements

The following can be de-priorized

- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation: can be deprioritized, NTN-TN and NTN-NTN mobility and service continuity enhancements should be sufficient in Rel-18
- Regenerative Payload with Inter-Satellite Link (ISL): It can be up to gNB implementation

- Enhanced beam management: can be de-prioritized. This was discussed in Rel-17 extensively and need for enhancements was unclear. Rel-15 NR beam management can be used.
- Study of DL PAPR reduction: No clear need for this, can be left to gNB implementation (i.e. distortion algorithms, ..)
- Study of UE without GNSS: The need is un-clear and is not backward compatible in gNB, and would require specification of a very different system with huge impact on the core specification, implementation, and testing.

2 – ZTE Corporation

We are fine with the moderator's suggestion and all these topics can be deprioritized in Rel-18.

3 – MediaTek Inc.

On support of HD-FDD with NR NTN, it is a major enabler of NTN due to UE economies of scale in low bands (sub3GHz) (smartphone economics). Support of HD-FDD, support for NTN is enabled without requiring any additional band-specific duplexers. Deployments in NTN-only bands (i.e. with NO TN equivalent) will likely be jeopardized by lack of availability of duplexers.

- Re-use RedCap work as a starting point, but avoiding RedCap BW/antenna restrictions

4 – Classon Consulting

for FUTUREWEI OK to deprioritize, thought we prefer working on regenerative payload to some of the earlier objectives.

5 – Ligado Networks

We agree with the moderator proposal.

6 – Lockheed Martin

Regenerative Payloads + possibly ISL for NR-NTN:

Although we were unable to provide our inputs for the initial round, we would like to express our support for Regenerative Payloads (possibly including ISL), along with Omnispace, Rakuten, DOCOMO, Samsung, Huawei, Apple, MediaTek, Sony, OPPO, Lenovo-Motorola, LG, Fraunhofer, Classen Consulting, CATT, who expressed similar support in the initial round. Here are our reasons:

It has been already recognized that regenerative payloads are the next step in the logical evolution of the initial transparent-payload solutions. Several benefits of regenerative payloads have been identified, including: reduction of network latency, simplifications & improvements resulting from the decoupling of the service & feeder links, potential for multi-hop networks (using ISLs) for areas such as oceans, where gateways are not possible, enhanced network operation by coordinated satellite nodes by sharing measurements, etc.

Previous studies had looked at two architecture options, namely full-gNB on board with an NG interface to the ground-based core network and gNB-DU (as defined by 3GPP) with F1-interface to the ground-based gNB-CU. To varying degrees, both these architectures have a set of elements for potential standardization and performance characterization.

For example, the full-gNB-payload case includes: Specification of the network architecture including interface impacts, maintenance of the NG interface between satellite gNB and the 5GC, enhancements to solve the feeder link switch issues due to satellite movement, enhancements on network interface protocols considering limited capacity of ISL, impacts of extra-delay over NG interface due to multi-hop ISL etc.

Similarly, for gNB-DU-payload architectures, some additional aspects that need to be explored are: simplified mobility schemes (compared to full-gNB-payload scenario), dynamic switching of F1 interface between multiple gNB-CUs, inter-gNB-DU ISL interfaces etc.

We therefore urge the NTN community to consider treating this important topic as a non-controversial topic. In terms of planning, a possibility is to focus on full-gNB-payload first (perhaps combined with full-eNB-payload solutions being considered for IOT-NTN), and subsequently address split-gNB-payload solutions and ISLs.

7 – InterDigital

In general supportive of Moderator proposal, however similar to DAPS we do still see some benefit in enhanced asynchronous multi-connectivity and carrier aggregation for service continuity. Since there wasn't consensus in initial round a dedicated objective may not be agreeable, but as a compromise we think it should not be precluded from consideration to satisfy core service continuity objectives.

8 – DOCOMO Communications Lab.

We do not understand why these topics are deprioritized based on "controversial" while it seems that also 1.2.1.1/1.2.1.2/1.2.1.3/1.2.1.4 are still controversial. We suggest to include regenerative payload with ISL and UE without GNSS in Rel-18, which have a lot of supports. Regarding workload perspective, coverage part can be only study and work might not be necessary, and NTN pos should be discussed in positioning SI/WI, then not so wide currently.

9 – China Mobile Group Device Co.

If time allows, we still hope to discuss regenerative architecture and spectrum re-use/sharing.

10 – LG Electronics Inc.

We strongly suggest that multi connectivity & carrier aggregation should be discussed in Rel-18. For the commercialization perspective, data rate of NTN is too low. So increasing the data rate is important role in the next NTN releases.

Regenerative payload & ISL also should be discussed in Rel-18 to reduce propagation delay in NTN.

11 – THALES

We would like to prioritize in Rel-18 the support of NTN-NTN asynchronous multi-Connectivity

With the proposed set of objectives (assuming leveraging existing Multi/Dual connectivity feature):

· *Address different delay and/or network topology between the different access points/satellite nodes. [RAN1, RAN2]*

· *Handling different time and frequency compensation [RAN1]*

· *Master node versus secondary node selection [RAN3]*

We agree with Mediatek that MBS should be supported in NTN based on Rel-17 NR MBS without enhancements

12 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We still prefer to consider the following topics for NR NTN.

- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Regenerative Payload with Inter-Satellite Link (ISL)
- Enhanced beam management

13 – CATT

Among these controversial topics, we preferred to go for regenerative payload and ISL in Rel-18. Regenerative architectures have been studied in Rel-16. Support of Regenerative payload and ISL allows more choices for NTN network deployment, and make the resource coordination between gNBs more efficient, etc. Furthermore, regenerative payload and ISL is the most essential condition to support the feature "Store and Forward" raised in IoT NTN.

If we only focus on full gNB on board case, the main impact should be in RAN3, on handling of the architecture aspects. The workload should be acceptable as there's not too many RAN3 related items.

For ISL, it could be taken as a transport layer, no specification work is needed.

Above all, suggest to support Regenerative payload and ISL with the following assumptions:

- Only support full gNB on board case,
- ISL is taken as a kind of transport layer, no specification impact.

The Potential objective:

- Specify the network architecture, including interface impacts, for the architecture option for regenerative payload, i.e. full gNB on-board. [RAN3]

14 – Ericsson LM

We agree with the Moderator's observation. A couple of additional reflections on the architecture discussion. If we decide to stick to transparent architecture for Rel-18 (due to e.g. no consensus on regenerative architecture), we see a couple of risks: 1) we might be creating unnecessary barriers for e.g. mobility, or risk missing out on inherent mobility benefits; 2) any mobility or coverage enhancement that we are considering will risk being irrelevant, as they heavily depend on the architecture. Essentially, we would be re-discussing the same issues as in Rel-17.

15 – NOVAMINT

Our comments on some topics:

- Regenerative Payload with Inter-Satellite Link (ISL) – see our comment on HAPS + we should separate anyway Regenerative Payload and ISL
- Study of UE without GNSS – we still believe that the only chance to address this topic is in Release 18 (likely no return point possible afterwards) and it is not for UE without GNSS only but to allow a path for less dependencies to GNSS
- Spectrum re-use/sharing – this needs to be addressed in RAN4 discussion

16 – Intel Corporation SAS

We agree with moderator's recommendation to stop the discussion on the listed items.

17 – Sony Europe B.V.

We agree on the list of RAN2 topics (including on MBS) but we also feel that ISL may need some work in RAN3 regarding the F1/Xn interface between satellites.

18 – HUGHES Network Systems Ltd

We agree with the moderator's proposal but suggest to prioritize "NTN-NTN asynchronous multi-Connectivity"

19 – Nokia France

In view of arriving at a manageable workload, we support the Moderator's suggestion.

20 – Rakuten Mobile

We support below objectives strongly & should be included .

- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Regenerative Payload with Inter-Satellite Link (ISL)
- Study of UE without GNSS
- Spectrum re-use/sharing

21 – HUAWEI TECHNOLOGIES Co. Ltd.

On regenerative satellite, we think it is an important use case to provide service coverage where no GW are/can be deployed. It was included as part of study item in TR38.821 and the specification impact is mainly RAN3:

- Specify the network architecture, including interface impacts, for the regenerative satellite, e.g. on-board gNB, CU-DU split, including possible down-selection. [RAN3].

22 – Gatehouse Satcom A/S

Our inputs relate to:

- **Support for Regenerative Payload** - Inter-Satellite Link (ISL) and Regenerative Payload should be separated.

- **Study of UE without GNSS** - Better to formulate as "UE independence from GNSS" since the study should relate to seek options for less dependencies to GNSS for the UE. If not done in Rel-18, it likely is no longer relevant/possible to consider modifications to the specifications for this.

23 – Fraunhofer IIS

We prefer to consider the following topics:

- Study of UEs without GNSS:
  - In the first round of discussion around 20 companies were supportive/fine/ open-to-further-discussion with respect to this topic.

- Support of MBS
- Study of DL PAPR reduction
- Regenerative Payload with Inter-Satellite Link (ISL)

2.1.1.6 HAPS (High Altitude Platform System)

During the Initial Round, some companies expressed the need to have further discussions on NR support of HAPS. This topic was previously covered in the Additional RAN1/2/3 topic set 2 thread during the RAN93e Rel-18 Prep discussion and summarized in RP-211665. The RAN Chair confirmed that any topics from the Additional RAN1/2/3 threads that were going to have further email discussions prior to RAN#94e were already assigned in RP-212657 based on slide 14 of RP-212608. HAPS was not intended to be discussed either separately from or part of the NTN email thread.

However, in order to provide companies a mechanism to collect additional viewpoints on HAPS, a separate feedback form has been added to the Intermediate Round. The intent of this feedback form is only to collect the input as part of the RAN94e Rel-18 Prep discussion. The is no intent to develop a way forward for this topic as an output of the NTN Evolution RAN94e Rel-18 Prep discussion based on the RAN Chair's guidance.

Feedback Form 23: HAPS (High Altitude Platform System)

1 – China Mobile Group Device Co.

We are neutral for HAPS.

2 – Samsung Electronics Co.

We are open to discuss, and what to be more studied/supported for HAPS beyon Rel-17/18 NTN should be discussed first.

3 – THALES

We are open to have HAPS be treated in a Rel-18 NR-NTN work item. However relevant HAPS scenarios need to be clarified. This would help to identify specific issues if any compared to satellite.

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are supportive of having a WI in NTN to discuss the HAPS with following objectives

- Development of HAPS deployment and configuration scenario(s), which are not studied and/or missing in TR38.821.
  - Determination of HAPS scenario(s) including inter-HAPS link (RAN1/4)
  - Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)
  - Mobility, beam management, and interference study considering spectrum (RAN1/2)
  - Applicability of TDD from remote interference PoV (RAN1)
  - Applicability of regenerative and transparent payload (RAN2/3)

5 – VODAFONE Group Plc

We believe that it is useful that 3GPP supports the use of HAPS so we support some limited work on this (e.g. we are not sure that we need inter-HAPS links to be studied). Compared to NTN, with HAPS it is more likely that the gNB is included in the aerial platform so this may need some short study.

6 – SoftBank Corp.

Firstly, we would express our thanks to moderator for accepting our request to prepare a specific discussion place for HAPS.

This is just to echo what we mentioned, but it is important to complete the study on HAPS because 3GPP hasn't defined any HAPS scenarios and RAN companies have no common understanding. This implicitly means that the NTN optimization functionalities in Rel-18 will be defined without considering HAPS scenarios. Thus again, we support the potential scope shown by Lenovo above.

7 – CATT

HAPS has been considered and supported in R17, so additional enhancements are not very necessary if without clear justification.

8 – NOVAMINT

We are open to have HAPS be treated in a Rel-18 NR-NTN work item and we agree with Thales that relevant HAPS scenarios need to be clarified.

We also would like to outline that if HAPS is part of NR-NTN we should then consider more the topic of the regenerative payload with a focus on the full gNB on board option.

9 – Ericsson LM

We agree with the Moderator and the RAN Chair's observations.

10 – Intel Corporation SAS

We acknowledge that HAPS is an important scenario to achieve better coverage of NR. In the same time, in our view at this stage it is better to focus on particular items which require specification impact to enable HAPS with NR (i.e. anything that is missing from the specs when considering the work that has already been done to support NTN).

11 – HUGHES Network Systems Ltd

We are open to have HAPS be treated in a Rel-18 NR-NTN work item. However relevant HAPS scenarios such as spectrum (topics in RAN4) and its requirement for regenerative payload should be treated separately.

12 – HUAWEI TECHNOLOGIES Co. Ltd.

We suggest to explicitly include HAPS as an objective in Rel-18 NTN, including updating TR38.821 based on the HAPS-specific deployment and configuration.

2.1.2 Evolution of IoT (Internet of Things) NTN

Please provide any input on the overall justification section for the proposed WID for Evolution of IoT NTN. At this time, the topics of Evolution of NR NTN and Evolution of IoT NTN are kept separate for email discussion purposes. As it is not yet confirmed if they will be handled together or as separate WIDs, please provide the overall justification for Evolution of IoT NTN separately at this time.

Feedback Form 24: Evolution of IoT NTN Justification

1 – MediaTek Inc.

We are generally supportive of moderator proposal. We think some further de-scoping and prioritization will be needed to ensure RAN1 and RAN2 objectives can be completed with Rel-18 timeframe and TU budget allocation. Discussions should focus on the non-controversial topics

2 – China Mobile Group Device Co.

Agree with moderator to further downselection.

3 – THALES

Here under our proposed input for the overall justification section for the proposed WID for Evolution of IoT NTN:

In Release 17, a work item is carried out to define the enhancements enabling NB-IoT and eMTC to support Non-Terrestrial Networks (NTN) for a minimum first version under the following assumptions:

- *Transparent payload based NGSO network scenarios (down to 600 km altitude) addressing at least 3GPP class 3 UE with GNSS capability in both Earth fixed &/or moving cell configurations.*
- *Transparent payload based GEO network scenarios addressing UE with GNSS capability.*

As part of release 18, a new work item is proposed to define further enhancements for NB-IoT NTN and eMTC NTN in order to

- *Improve intra-NTN mobility*
- *Improve performance in terms of throughput*
- *Support of store-and-forward operation*

4 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are supportive of moderator proposal to further downselection.

5 – NOVAMINT

We believe that an IoT NTN package containing the below 4 main objectives would be a very reasonable and coherent package

- IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17 (with some prioritization & down scoping like proposed in section 1.2.2.1)

- Mobility enhancements (with some prioritization & down scoping like proposed in section 1.2.2.2)
- Further enhancement to discontinuous coverage
- Support for store-and-forward on-board NTN payload

Such package will allow to address the key technical issues as well as to take into account the commercial perspectives in order to make 3GPP the most relevant solution for IoT NTN as well as for IoT TN and to reach a large market adoption.

6 – Ericsson LM

In general, we are OK with the proposed handling.

7 – HUGHES Network Systems Ltd

We support Rel-18 enhancements for NB-IoT NTN and eMTC NTN:

- Improve intra-NTN mobility
- Improve performance in terms of throughput
- Support of store-and-forward operation

8 – Rakuten Mobile

We support moderators proposed handling

9 – Nokia France

We would like to re-emphasise that eMTC and NB-IoT are a different RAT from NR, so this should be separated from the NR-NTN discussion.

10 – HUAWEI TECHNOLOGIES Co. Ltd.

We support moderator proposal to include disabling HARQ in the Rel-18.

We are fine to discuss PUR related issue further when more progress is made in the WGs in Rel-17.

We support moderate's request for further clarification of some proposals. We understand that without clear clarification, these proposals will not be included in Rel-18. Regarding improved GNSS operations for a new position fix for UE pre-compensation during long connection times, similar proposals are being discussed in Rel-17 (see R1-2110645 section 2.5.2). If this was specified in Rel-17, it is not clear what additional enhancement is needed in Rel-18.

11 – HUAWEI TECHNOLOGIES Co. Ltd.

Sorry. Please ignor the above input from Huawei, it is supposed to be input into the next feedback form.

12 – Sony Europe B.V.

Proposed justification text:

A release-17 study item on IoT-NTN investigated enhancements to eMTC and NB-IoT in order to support operation over NTN. This study was terminated early so that essential minimum functionality for the support of IoT-NTN could be specified in a release-17 IoT-NTN work item. It is now necessary to consider IoT-NTN enhancements that go beyond essential minimum functionality and that allow the 5G mMTC requirements to be met over IoT-NTN.

Initial deployments of IoT-NTN may not support full satellite constellations. There is hence a need for the support of discontinuous coverage and store and forward capabilities.

2.1.2.1 IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

Leading WG = RAN1, Secondary WG = RAN2

Potential interaction with SA/CT: None

The following objective had broad support.

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1,RAN2]

Further clarification was requested on the following objectives in order to fine tune the objectives.

- Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption [RAN1]
- Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN [RAN2,RAN1?]
- Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN [RAN2,RAN1]

The following objective which was in brackets was proposed to handle under "Further enhancement to discontinuous coverage" or that it is already planned to be covered in Rel-17 IoT-NTN WI at least for geostationary satellite (FFS for NGSO). Given that there was no consensus to handle this objective under discontinuous coverage in the RAN93e Rel-18 Prep discussions, the moderator asks the proponents to provide further justification on the following objective if it is to be treated in Rel-18 IoT NTN work.

- Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage

Feedback Form 25: IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

1 – MediaTek Inc.

We support disabling HARQ feedback and improved GNSS operations (i.e. spare use of GNSS) as first and second priorities respectively.

On packet interruption, in IoT NTN, the beam size can be very large – i.e. typically 1000 km up to 1700 km with single beam, two beams, or small number of beams. The UE will be in coverage of a satellite for typically 2 minutes and will need to switch a beam every minute or so. For IoT NTN, we do not see packet interruption as a significant issue as would normally happen during beam switching and typical IoT NTN services have lesser latency requirements than NR NTN.

For similar reasons as discussed for packet interruption, we do not see a strong need for beam switching enhancements that would justify the significant impact on specification.

2 – ZTE Corporation

We prefer to focus on the HARQ disabling and improved GNSS operation in Rel-18 as the 1st priority. For others,

- Carrier-specific configuration, it's not clear about the motivation and spec impacts, whether and how to map the carrier to beams is mainly up to gNB.
- For the "Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN", it is not an essential issue for IoT with a large beam size.
- Power saving enhancements including PUR to support discontinuous coverage: in Rel-17, PUR is only supported for GEO and further discussion in LEO can be considered in Rel-18. It can be taken as the 2nd priority along with the discussion on further enhancement to discontinuous coverage in section 1.2.2.3

3 – Classon Consulting

for FUTUREWEI OK with focus on disabling HARQ

4 – InterDigital

Support disabling of HARQ feedback and improved GNSS operations for UE during long connection times as first priority.

5 – China Mobile Group Device Co.

Support that HARQ enhancement goes first, then improving GNSS operation could be considered.

6 – Qualcomm Incorporated

Not sure what is meant by "further clarification was requested" above the GNSS aspect. If TU budget is limited, maybe it makes sense to not do a PRACH re-design. But inputs from companies must be clearly sought on these aspects: i.e., whether we pursue "GNSS-free" or "no GNSS in CONNECTED mode (even for long connections)" operation.

Also, as mentioned before, not sure why the carrier selection aspect is showing up here. This is still ongoing in RAN2 even for terrestrial, at this stage.

Additionally, support of PUR can be discussed as a leftover item

7 – Asia Pacific Telecom co. Ltd

We support to discuss HARQ enhancement & GNSS improvement firstly.

8 – Samsung Electronics Co.

We think disabling of HARQ feedback and improved GNSS operations are high priority topics. We are open to consider enhancements related to NB-IoT carrier selection. For the last objective, we are fine with PUR for NGSO since Rel-17 supports PUR for GEO, and prefer a well-defined scope.

9 – Beijing Xiaomi Mobile Software

We are fine to include the HARQ disabling to mitigate the HARQ stalling issues. Meanwhile, we also think the Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption should be included. This is discussed in Rel-17 and is a necessary enhancement.

10 – Gatehouse Satcom A/S

We support the prioritizing on the disabling of HARQ feedback and improved GNSS operation for UE during long connection times and to deprioritize the remaining.

11 – THALES

The first proposed set of objectives from moderator are agreeable.

The second set of objectives can be de prioritized

12 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We think the PUR bullet can be handled under "Further enhancement to discontinuous coverage".

13 – NOVAMINT

We support to prioritize disabling HARQ feedback and improved GNSS operations.

We are fine as well to address "Further power saving enhancements including PUR for IoT NTN..." for NGSO in Rel-18 and it should be added to section 1.2.2.3

14 – CATT

The following objective may bring some confusion:

"Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN [RAN2,RAN1]"

We suggest some clarification or modification.

For this objective "Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN [RAN2,RAN1?]" We still think that, some clarification on coverage enhancement is needed, e.g. coverage enhancement will be included in IoT NTN R18 WID or not. Or, the output of NR NTN will be reused here, for there is a suggested objective of coverage enhancement in the NR NTN WID discussion in section 1.2.1.1. otherwise, we are not sure how we can have the "coverage level" in "based on the coverage level".

15 – Ericsson LM

If disabling of HARQ mechanism is to be specified for IoT devices in Rel-18, it should be formulated as "study and if found beneficial …." (as commented on other items), since so far evaluations have shown that with such data rates there seems to be no need for disabling HARQ. Besides even without any explicit disabling HARQ feedback mechanism eNB can schedule the UE regardless of whether HARQ feedback (or in particular ACK or NACK) is received. One can say that the main motivation can be reduction in UE power consumption by avoiding transmitting HARQ feedback but considering that these are short lived connections, and the power consumption is due to mainly what happens in idle mode that would not make much of a difference. On "improving GNSS operations" we understand that this is to ensure that the UE has a chance, e.g. a gap, to fix the position and TA pre-compensation when in connected mode. Furthermore,

we don't think it's necessary to emphasize PUR in the objectives; it should be enough to say "power saving enhancements to support discontinuous coverage".

16 – Intel Corporation SAS

For "Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption", we are not sure if it is really needed considering that Rel-17 GNSS measurements are still under discussion

For "Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN [RAN2,RAN1?]", it's not clear whether NB-IoT carrier selection can be applied in NTN, as NB-IoT carrier selection is based on the coverage level, but the distributions of signal quality from different carriers may be the same and all relatively flat.

17 – HUGHES Network Systems Ltd

We support disabling HARQ feedback and improved GNSS operations as priorities.

18 – HISPASAT SA

We support moderator's proposal.

19 – Rakuten Mobile

We support Disabling of HARQ ,Improved GNSS operations & Further power saving enhancements for IoT NTN to support discontinuous coverage.

20 – HUAWEI TECHNOLOGIES Co. Ltd.

We support moderator proposal to include disabling HARQ in the Rel-18.

We are fine to discuss PUR related issue further when more progress is made in the WGs in Rel-17.

We support moderate's request for further clarification of some proposals. We understand that without clear clarification, these proposals will not be included in Rel-18. Regarding improved GNSS operations for a new position fix for UE pre-compensation during long connection times, similar proposals are being discussed in Rel-17 (see R1-2110645 section 2.5.2). If this was specified in Rel-17, it is not clear what additional enhancement is needed in Rel-18.

21 – Sony Europe B.V.

We think these proposals do not go far enough.

The proposal on disabling HARQ feedback is presumably about increasing capacity (reducing PUCCH usage). Why aren't other capacity enhancements considered? We should also consider how to mitigate PRACH congestion, which will also affect IoT-NTN deployments. PRACH congestion is a capacity issue.

We don't understand the following objective:

Mechanisms for NB-IoT NTN <u>to mitigate packet interruption for NTN</u> **to mitigate packet interruption for NTN** [RAN2,RAN1]

Why is "to mitigate packet interruption for NTN" repeated twice? Why is this only applicable to NB-IoT and not eMTC?

We should either delete this objective or re-phrase it to something that is concrete and consistent.

2.1.2.2 Mobility enhancements

Leading WG = RAN2, Secondary WG = RAN1

Potential interaction with SA/CT: None

There were different views on the leading WG. The moderator proposes that RAN2 be the leading WG given the mobility aspects.

Additional comments were received that we should avoid different "flavors" of IoT only for NTN. Therefore, LTE-M and NB-IoT should be treated on the same level, and the differences between the two technologies should maintained (e.g. there should be no connected mode mobility for NB-IoT). To remove some redundancy in the list of objectives, the moderator proposes the following list based on the company input. Further clarification of the enhancements on RLF and RRC reestablishment is requested in order to focus the work. Please add additional detail as sub-bullets.

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]
- Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]
- Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration [RAN1, RAN2]

Additional clarification is requested on the following objectives in order to determine the need/justification and/or to focus any necessary work.

- RACH congestion reduction [RAN2]
- Reduce handover signaling overhead [RAN2]
- IoT-NTN and TN mobility enhancement [RAN2]
- Beam-level mobility [RAN1, RAN2]
- Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells [RAN1,RAN2]

Feedback Form 26: Mobility enhancements

1 – MediaTek Inc.

We are generally supportive of moderator proposal. Solution introduced in Rel-17 NR NTN (e.g. location-based CHO and timing-based CHO) for eMTC can be de-prioritized.

2 – ZTE Corporation

In general, the enhancement of mobility for IoT devices over NTN is not critical since the coverage of one cell is much large compared to the required service. We need to focus on the essential issues, e.g., RACH congestion to enable the system for massive IoT usage.

3 – InterDigital

Support Moderator proposal on primary objectives and lead WG. We think those listed under the "additional clarification is requested" section can all be deprioritized.

4 – China Mobile Group Device Co.

We are ok about the list of objectives suggested by the moderator. Additionally, considering the larger coverage of NTN, there may be a lot of UEs to perform RA or HO procedure almost at the same time, therefore, RACH congestion reduction and handover signaling overhead reduction are also important. Then IoT-NTN and TN mobility enhancement is needed as well due to the movement of some IoT UEs.

5 – Qualcomm Incorporated

We are not sure why "NB-IoT carrier selection based on the coverage level" is part of RLF/reestablishment enhancement. As we commented, beam-based mobility should have high priority as mobility enhancement to reduce interruption and power consumption.

For beam-level mobility, we think there should be a mention of Ncells with multiple anchor carriers (which was previously listed in another bullet of another section, but now seems to be omitted).

Also, we don't think the text on defining mechanisms to allow UE to continue long transmissions/receptions between cells is clear. We have stated in the previous round that for the "same physical" transmission/reception, this doesn't seem reasonable at all.

6 – Spreadtrum Communications

In NB-IOT, the duration for PRACH/PUSCH/PDSCH transmission is very long, especially with large repetition number. In LEO scenario, serving cell handover may occur frequently during the transmission time interval. From this point of view, in order to avoid handover during one transmission time interval as much as possible in IOT NTN, multiple satellite beams in one cell should be supported in IOT NTN. Therefore, beam level mobility should be considerded in R18. Furhermore, Define mechanism to allow UE to continue long PUSCH/PDSCH transmissions between cells also can mitigate packet interruption when serving cell handover occur during the transmission time interval.

7 – Samsung Electronics Co.

We are fine with the moderator summary of the mobility enhancements.

8 – Beijing Xiaomi Mobile Software

We support the first three bullets should be addressed with priority. For the IoT NTN and TN mobility, as we commented in the first round, R17 only considers the mobility in IoT-NTN network, so in Rel-18, the mobility between IoT-NTN and eMTC/NB-IoT should be addressed if UE supports both RAT types. We also think the RACH congestion reduction and reduce handover signaling overhead are not IoT-NTN specific issue, and it can be first studied in the NR NTN.

9 – THALES

The first proposed set of objectives from moderator are agreeable.

The second set of objectives can be de prioritized

10 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine with the first list of objectives.

For RLF and RRC reestablishment in IoT NTN, RLM procedure may not follow the movement of LEO and the conditions of triggering RLF may bring additional delay or signalling overhead in NTN. Considering that the mobility for NB-IoT is finally done by RRC re-establishment, a more straightforward way is to use the conditional concept as CHO, i.e. conditional RRC re-establishment.

11 – NEC Corporation

We believe issues below should be discussed in NR NTN first. Based on the solution for NR NTN, once critical issues have been identified, we can further consider the enhancement.

- RACH congestion
- NTN and TN mobility enhancement
- Reduce handover signaling overhead

12 – NOVAMINT

We are generally supportive of the moderator proposal (primary objectives and lead WG).

Solution introduced in Rel-17 NR NTN (e.g. location based CHO and timing-based CHO) for eMTC can be de-prioritized.

We would agree as well with Qualcomm that beam-based mobility should have high priority as mobility enhancement in order to reduce interruption and power consumption.

13 – CATT

We still think if the following objective can be completed in Rel17:

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]

We can have move time to discuss the following valuable objective:

- RACHcongestionreduction[RAN2]
- Reduce handover signaling overhead [RAN2]

it is important to improve the resource efficiency, for there will be so many UEs performing HO or network access at the same, especially for the earth-fixed cell scenario.

14 – Ericsson LM

We would prefer not to enhance RLF and RRC re-establishment, as already explained in detail in the first round. We should keep in mind that mobility is not supported for NB-IoT.

15 – Intel Corporation SAS

Ok to exclude the following objectives in R18 IoT NTN:

· RACH congestion reduction [RAN2]

· Reduce handover signaling overhead [RAN2]

· IoT-NTN and TN mobility enhancement [RAN2]

· Beam-level mobility [RAN1, RAN2]

· Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells [RAN1,RAN2]

16 – Sony Europe B.V.

In our opinion NR-NTN mobility enhancements should be the baseline. RAN should avoid discussing different solutions for IoT-NTN and NR-NTN except for obvious differences between NR and LTE.

17 – HUGHES Network Systems Ltd

The first proposed set of objectives from moderator are agreeable.

The second set of objectives can be de prioritized

18 – Rakuten Mobile

We are ok with main proposed objective & ok to add below objectives

- RACH congestion reduction [RAN2]
- Reduce handover signaling overhead [RAN2]
- IoT-NTN and TN mobility enhancement [RAN2]

19 – HUAWEI TECHNOLOGIES Co. Ltd.

On the second bullet, we would like to have more clarification on the motivation and the enhancements. It is worth noting that when RLF occurs, the UE performs cell selection to find a suitable cell as soon as possible to reestablish the connection. For conditional RRC reestablishment, if this mandates the UE to perform reestablishment with the conditional cells but the cell quality is not good as a suitable one, this brings undesirable latency than the legacy reestablishment procedure.

For the third bullet, in our understanding, the UE behavior to perform neighbor cell measurements is decoupled with the RLF detection procedure. It is unclear to us for the wording “corresponding measurement triggering before RLF”. We should further clarify the use case for this bullet.

20 – Sony Europe B.V.

We are OK with the objectives.

A RACH congestion issue arises because UEs will wait to read ephemeris information before transmitting. UEs with data to transmit will hence try to connect straight after ephemeris information is transmitted on SIB. There will be RACH congestion after SIB transmissions.

2.1.2.3 Further enhancement to discontinuous coverage

Leading WG = RAN2, Secondary WG = RAN3

Potential interaction with SA/CT: with SA2 and CTx WGs with respect the improvements related to the operation under discontinuous coverage, which is expected to be addressed from system architectural level and core network functionality in Rel-18.

The list of objectives and their scope is highly dependent on the outcome of Rel-17. Further refinement of the list will be needed once the Rel-17 outcome is known. The moderator has listed possible enhancements as sub-bullets based on company feedback. Further identification of any specific enhancements for the objectives below is encouraged to focus the work item objectives.

- Efficient power saving mechanisms (eDRX/PSM) for sparse satellite constellations [RAN2]
  - Enhancements in PSM timers requesting and configurations
- Improvements to UE mobility among sparse cells [RAN2]

Additional clarification and/or modification of the following objective is requested given that existing mobility is controlled by the network.

- Network-controlled mobility and multiple non-anchor carriers may be taken into account [RAN2, RAN3]

Feedback Form 27: Further enhancement to discontinuous coverage

1 – MediaTek Inc. We are supportive of moderator proposal. Wait for Rel-17 discontinuous coverage enhancements.
2 – ZTE Corporation We are supportive of this proposal.
3 – InterDigital Support Moderator proposal as a general first step and should wait for Rel-17 discontinuous coverage enhancements to progress before further refinement to the objectives.
4 – China Mobile Group Device Co. Support the updated objectives.
5 – Qualcomm Incorporated It is not clear to us why it important to capture" Enhancements in PSM timers requesting and configurations" as this is already ongoing discussion in RAN2. Maybe we need to revisit this objective after the next RAN2 meeting.

6 – Asia Pacific Telecom co. Ltd

We support the proposals (wait for the R-17 outcomes) & the possible objectives.

7 – Spreadtrum Communications

We are supportive of moderator proposal.

8 – Gatehouse Satcom A/S

We support the moderator's proposal and wait for Rel-17 discontinuous coverage enhancements and wait with further objective refinement.

9 – Beijing Xiaomi Mobile Software

We are fine with moderator's proposal.

10 – THALES

The first proposed set of objectives from moderator are agreeable.

The second set of objectives can be de prioritized

11 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine with the first list of objectives.

For "Improvements to UE mobility among sparse cells [RAN2]", enhancements in RRC reestablishment or recovery based on the discontinuity of coverage can be considered as a subset.

12 – ESA

We are fine with moderator's proposal.

13 – NOVAMINT

We are supportive of moderator proposal.

14 – CATT

For "Network-controlled mobility and multiple non-anchor carriers may be taken into account [RAN2, RAN3]", we do not understand what's the real issue to be addressed here and what's the expected target.

15 – Ericsson LM

OK in general, but "improvement to UE mobility among sparse cells" should be clarified further.

16 – Intel Corporation SAS

Regarding mobility part, the following two bullets can be merged and include both RAN2 and RAN3 as WG:

· Improvements to UE mobility among sparse cells [RAN2, RAN3]

- Network-controlled mobility ~~and multiple non-anchor carriers~~ may be taken into account [RAN2, RAN3]

But it's not clear how to apply multiple non-anchor carrier for mobility purpose.
17 – HUGHES Network Systems Ltd We support moderator's proposal.
18 – HISPASAT SA We support moderator's proposal.
19 – Rakuten Mobile We are ok in general to support moderators proposed objectives.
20 – HUAWEI TECHNOLOGIES Co. Ltd. We support moderator proposal to wait for further progress in Rel-17, and we believe there is no need to agree on any potential objectives before Rel-17 concludes discontinuous coverage.
21 – Sony Europe B.V. Support proposals

2.1.2.4 Other comments for controversial topics identified in RP-211658

There was no specific compromise proposal provided to drive consensus on this previously identified controversial topic of "**Support for store-and-forward on-board NTN payload**".

The solution also relies on the assumption of gNB on-board architecture which is also a controversial topic in the Evolution of NR NTN area. It is not clear if this work can be progressed unless there is a way forward in the Evolution of NR NTN area. A few companies also proposed including this topic in the IoT discontinuous coverage topic. In addition, the solution has a very large impact on SA/CT.

The moderator proposes that any further consideration of this topic be deferred at this time unless a compromise proposal is presented that can address the concerns raised by multiple companies during both email discussion periods.

Given that company views have not changed, the moderator suggests stopping further discussion on these topics prior to RAN#94e. If companies would like to continue working towards consensus, proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions to work on possible compromise solutions. Any further views and/or compromise proposals can be provided in the general feedback from provided in the Intermediate Round or taken as company input at RAN#94e.

Feedback Form 28: General feedback for controversial topics identified in RP-211658

1 – MediaTek Inc. We see this topic of Support for store-and-forward on-board NTN payload as important to support global IoT NTN coverage at least for LEO.

2 – Lockheed Martin

We support the idea of the topic of store-and-forward (using regenerative techniques) with eNB-payload potentially combined with regenerative gNB-payload for NR-NTN.

3 – China Mobile Group Device Co.

Neutral for this.

4 – Sateliot

We support the topic of store-and-forward (using regenerative payload with eNB/ng-eNB onboard) for global IoT NTN coverage. If more convenient, we would also support addressing this topic in combination with the topic of discontinuous coverage, as both topics together serve the same purpose: realization of affordable NGSO constellations for global IoT NTN services (discontinuous coverage allowing for sparse constellations; and S&F allowing for sparse ground-segment networks and coverage of areas where GWs cannot be deployed)

5 – Gatehouse Satcom A/S

We agree with Mediatek, Lockheed Martin and Sateliot: Store-and-forward (using regenerative payload with eNB/ng-eNB onboard) is important to service IoT NTN globally, seen from a LEO perspective. It would be a benefit to combine S&F and discontinuous coverage, since they go hand-in-hand for LEO and both need to be considered during system level discussion.

6 – THALES

The support of store and forward for IoT-NTN should be considered

7 – ESA

The support of ”Store and Forward” is a very important feature for IoT-NTN.

8 – NOVAMINT

We agree with Mediatek, Lockheed Martin and many others that support for store-and-forward on-board NTN payload as important to support global IoT NTN coverage at least for LEO.

There are indeed strong impacts on SA/CT but we believe this is likely to be addressed by those groups in Rel-18 as store and forward is one of the new aspects of IoT NTN (like discontinuous coverage) which is beneficial to be addressed by 3GPP to support cost effective commercial deployments which are crucial for market adoption. We believe then that the impacts on RAN in terms of TUs would be limited.

9 – CATT

We’re supportive on the topic “Support for store-and-forward on-board NTN payload”.

Store and forward operation allows scaling service coverage and reach any area with a sparse number of GWs.

This topic relies on the assumption of eNB on-board architecture, which is linked to the topic “support of regenerative payload and ISL” for NR NTN.

To further progress, we can focus on eNB on board architecture for S&F in IoT NTN. The solutions for Regenerative payload in NR NTN could be reused for IoT NTN.

We see there's not too much effort required to support regenerative payload with only full gNB/eNB on board option, and there's not too much topics to be handled for IoT NTN in Rel-18, the workload should be acceptable.
10 – Ericsson LM We agree with the Moderator.
11 – Intel Corporation SAS We agree with moderator's recommendation.
12 – HISPASAT SA We support "Store & Fordward" feature in IoT.
13 – HUGHES Network Systems Ltd We are supportive of the store-and-forward feature to support global IoT NTN coverage.
14 – Rakuten Mobile we are ok with moderator's proposal.
15 – HUAWEI TECHNOLOGIES Co. Ltd. Agree with the moderator on the potential impact to SA/CT.
16 – Eutelsat S.A. We are supportive of the store-and-forward feature.
17 – Sony Europe B.V. Store and forward can be considered

2.2 Moderator Summary and recommendation for further discussion

Please see Final Round section for the moderator summary on each topic as well as the recommendations for further discussion.

3 Final Round

3.1 Collection of company views

3.1.1 Evolution of NR NTN (Non-Terrestrial Networks)

After consideration of all of the company input, the moderator has prepared a separate draft WID for Evolution of NR NTN as there is no consensus to treat it in the same WID as Evolution of IoT NTN given the different RAT. In addition, the study objectives for "Network based UE location" have been included in the

draft WID in order to capture them somewhere for now. Final determination if the study objectives will be included in a separate Study Item or handled in the Expanded and Improved Positioning WI will need to be made at RAN#94e.

There were no objections to the responsible WGs and the potential interaction with SA/CT.

Please find the draft WID with the proposed justification and list of objectives based on the summaries for each topic below at https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5BRAN94e-R18Prep-13%5D/Draft%20RP-21xxxx%20WID%20NR%20NTN%20Evolution.doc.

Please provide your feedback on the proposed justification section in section 3 of the draft WID as well as any comments outside of section 4 of the WID. The section 4 feedback will be captured in the feedback forms for each topic. The Final Round will be used to drive towards a final list of areas/objectives.

Feedback Form 29: Draft WID feedback on justification/others

1 – ZTE Corporation

We are in general fine with the description on WID, and the following updates are preferred:

For the justification: In previous releases, actually, all satellite types (e.g., GEO and NGSO with different altitudes) have been considered with transparent payload. Then, the following updates are preferred:

- Transparent payload based **GEO and** NGSO network scenarios ~~**(down to 600 km altitude)**~~ addressing at least 3GPP power class 3 UE with GNSS capability in both Earth fixed and/or moving cell configurations

For the objectives (section 4): Since the discussion in Rel-18 is to further enhance the performance without the introduction of new architecture, it's preferred to highlight the transparent payload as part of the assumption. Moreover, both VSAT and commercial handset terminals should be considered for FR1. Then, the following updates are preferred

- GEO and NGSO (LEO and MEO) **with transparent payload.**
- **Both "VSAT" devices with directive antenna (including fixed and moving platform mounted devices) and** commercial handset terminals are supported in FR1 (e.g. Power class 3)

2 – Intelsat

We are generally ok with the description in the WID, however where VSAT is mentioned we would prefer it were replaced by VSAT/ESIM.

We suggest the following change to the justification,

- Transparent payload based **GEO and** NGSO network scenarios ....

3 – DOCOMO Communications Lab.

This comment is for the beginning of the objective section since there is no corresponding comment box.

We know that moderator's intention is to preclude HAPS-specific study from Rel-18 NTN, but even in this case, at least the same text from Rel-17 WID should be kept to include implicit HAPS (and ATG) support. So we suggest to update as follows:

–

The work item aims at specifying enhancements for NG-RAN based NTN (non-terrestrial networks) according to the following assumptions **with implicit compatibility to support HAPS (high altitude platform station) and ATG (air to ground) scenarios**:

- GEO and NGSO (LEO and MEO).
- Earth fixed tracking area. Earth fixed & Earth moving cells for NGSO
- FDD mode
- UEs with GNSS capabilities
- Commercial handset terminals are supported in FR1 (e.g. Power class 3)
- Only "VSAT" devices with directive antenna (including fixed and moving platform mounted devices) are supported in above 10 GHz bands.

4 – THALES

We agree with the proposed justification in the draft WID. However we suggest to further clarify one point:

"Offer optimized performance especially when addressing handset terminals ***(including smartphones with <0 dBi antenna gain)*** *w.r.t. coverage and mobility/service continuity considering the NTN characteristics such as large propagation delay and satellite movement."*

5 – Eutelsat S.A.

We agree with the proposed justification in the draft WID.

6 – MediaTek Inc.

We are fine with justification.

7 – NOVAMINT

We are generally supportive of the proposed justification in the draft WID.

We would agree with the change proposed by Intelsat on replacing VSAT by VSAT/ESIM

8 – Intelsat

We agree with DOCOMO's comment pertaining to HAPS.

9 – HUGHES Network Systems Ltd

Hughes/EchoStar is supportive of the proposed justification in the draft WID.

In section 4.1 Objective - we agree with proposal by Intelsat to replace VSAT by VSAT/ESIM OR further clarify with a Note: In Rel-17 WID, "VSAT" device with external antenna on moving platform is equivalent to a device that operate on platforms in motion and this is referred to as ESIM.

Section 4.1 of Rel-17 NTN WID:

- *"VSAT" devices with external antenna (including fixed and moving platform mounted devices) at least in FR2 are supported for the RAN1-3 specifications. "VSAT" characteristics in TR 38.821 can be assumed for the RAN1-3 specifications.*

10 – Apple AB

We are fine with the moderator's wording.

11 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

The justification in the draft WID is fine.

12 – Beijing Xiaomi Mobile Software

The supported UE type includes handheld UE and VSAT devices, it is better to concretely described. Meanwhile, it is suggested to explicitly includes the smart phone with -5dBi antenna gain. The proposed updates are as follows:

In Release 17, a work item was carried out to define solutions enabling New Radio and NG-RAN to support Non-Terrestrial Networks (NTN):

- Transparent payload based NGSO network scenarios (down to 600 km altitude) addressing at least 3GPP power class 3 **handheld** UE **and VSAT devices** with GNSS capability in both Earth fixed and/or moving cell configurations
- Transparent payload based GEO network scenarios addressing UE with GNSS capability

As part of Release 18, a new work item is proposed to define enhancements for NG-RAN based Non-Terrestrial Networks in order to:

- Support new scenarios to cover deployments in frequency bands above 10 GHz
- Offer optimized performance especially when addressing handset terminals **including smart phone with -5dBi antenna gain** w.r.t. coverage and mobility/service continuity considering the NTN characteristics such as large propagation delay and satellite movement.
- Address requirements associated with regulated services regarding a network verified UE location i.e. to be able to check the UE reported location information.

13 – HISPASAT SA

We are ok with moderator's wording, and agree on ZTE's and Thales' modifications.

14 – ESA

We are fine with moderator's proposal and VSAT/ESIM change. The text proposed by Echostar is good for this clarification.

15 – China Mobile Group Device Co.

Agree the WID scope, and transparent payload is needed to add under the assumption if regenerative architecture is determined not to cover in NTN R18.

16 – Ericsson LM In general, we are fine with the justification. We would question the inclusion of the bullet on network-verified UE location: these aspects are being discussed as we speak in Rel-17, and so far no real shortcomings have been identified. We would propose to at least wait until the finalization of Rel-17 to add that part.
17 – HUAWEI TECHNOLOGIES Co. Ltd. Agree with the modification suggested by DOCOMO for HAPS and ATG.
18 – CATT We're fine with the proposed justification in the draft WID.
19 – Gatehouse Satcom A/S We are supportive to the moderator's proposal.
20 – Intel Corporation SAS In our view it is better to have a separate WID on NTN > 10 GHz bands, since it has an isolated RAN4-oriented scope and may eventually have different timelines. Also, performance part objectives in NTN WID are applicable to NTN > 10 GHz bands and it should be clarified. Now they are written in a way applicable to all sub-topics. The RAN4 Performance part objectives for the remaining part should be further discussed once the scope is stabilized.
21 – SoftBank Corp. We also support the proposal by Docomo to clarify the support of HAPS and ATG.
22 – Deutsche Telekom AG We agree with DOCOMO's proposal to include implicit HAPS support.

3.1.1.1 Coverage enhancements

In order to address the commercial smartphone use case, it is the moderator's view based on the previous email discussions as well as the discussions so far that the majority of companies have expressed the view that there is a strong possibility that the first two bullets of NTN-specific objectives from the candidate set are likely to be needed. Therefore, the moderator proposes to keep them listed in order to allow for more accurate TU planning.

The performance improvement of low-rate codecs in link budget limited situation has been placed in brackets for now with an additional note that the intent is to optimize the RAN to work with the lowest rate codec currently available and will not introduce a new codec.

An additional statement has been added that the candidate set of NTN-specific objectives may need to be updated/refined based on the outcome of the evaluation phase.

There did not seem to be strong support for adding the list of objectives where additional justification was

requested. For now, the moderator recommends removing them from the list of objectives. It is understood that if they are later identified as needed during the evaluation phase that they can be added at that time.

There was a suggestion from Qualcomm to clarify the second NTN-specific objective from the candidate set by using the following text.

- Study, and if justified, specify NTN-specific techniques for improved diversity and/or reduced polarization loss [RAN1]

In the final round, please provide your views if the Qualcomm suggestion is preferred over the existing text for the second NTN-specific objective listed below in the proposed objectives. Use the feedback form below only to address this issue. There is a separate feedback form below the proposed objectives to capture the full view.

Feedback Form 30: Views on Qualcomm clarification

1 – ZTE Corporation There is no need to list the candidate solutions in SI since we will start with the evaluation for certain scenario as highlighted in the replies below.
2 – Intelsat We support the proposal.
3 – DOCOMO Communications Lab. We have same view with ZTE. No need to list the candidate solutions. Instead, the following text should be added. - RAN to determine in RAN#XX whether there is to be specification support in Rel-18 or not.
4 – Guangdong OPPO Mobile Telecom. we think adding candidate solutions are fine. Moreover, think that we should take different priority levels for different deployment scenario. If coverage enhancement is to be supported in R18, we suggest to treat LEO 600 scenario with higher priority.
5 – THALES *We agree with the suggestion from Qualcomm to clarify the second NTN-specific objective.*
6 – vivo Mobile Communication Co. Since we have to evaluate and identify coverage issue first, it is too early to narrow down the scope of potential enhancement areas. For the second bullet of candidate set, the meaning of NTN-specific diversity techniques needs further clarify. It should be noted that diversity transmission was left to implementation since NR Rel-15. Suggest to revise the candidate set objectives as follows: - Study, and if justified, specify NTN-specific techniques for the relevant channels that have coverage issues, e.g., repetitions enhancements, etc.

7 – NOVAMINT

We support the proposal

8 – HUGHES Network Systems Ltd

We agree with moderator's proposal and support suggestion from Qualcomm to clarify the second NTN-specific objective.

9 – Apple AB

No strong views. Even if polarization loss is not flagged here, it can of course be discussed during the course of the WI.

10 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We prefer the existing text in the objective list

11 – Qualcomm Incorporated

The clarification is necessary since reducing polarization mismatch between the transmitter and the receiver may not be considered as a diversity technique.

12 – Samsung Electronics Co.

We don't think the candidate list is needed.

13 – LG Electronics Inc.

We also think there is no need to list the candidate solutions, since evaluation for the coverage performance identifying the channel having NTN-specific coverage issues should be done first.

14 – Beijing Xiaomi Mobile Software

Not sure if it is common understanding that the polarization mismatch between transmitter and receiver should be an issue that need to be resolved in Rel-18. As in Rel-17. we already have this kind of polarization loss. Our understanding on Rel-18 NTN CE enhancements is due to the support of smart phone.

15 – Asia Pacific Telecom co. Ltd

We support the Proposal and it is fine to keep QC's suggestion.

16 – ESA

We agree with the moderator and we support QC text.

17 – China Mobile Group Device Co.

There is no need about the candidate solution.

18 – Ericsson LM

We are OK with the proposed clarification, with the understanding that "if justified" means "if RAN1 identifies any shortcomings with currently used techniques in this scenario."

19 – HUAWEI TECHNOLOGIES Co. Ltd. The work on coverage enhancement will start with a study phase to identify the potential bottleneck channel for NTN specific characteristics. We did not see the need for such clarification at this stage.
20 – CATT We're fine with the clarification.
21 – Nokia France We agree with other companies that mentioning candidate solutions is not needed.
22 – Intel Corporation SAS We are open to consider solutions to improve coverage reducing of polarization loss in the study phase.
23 – Fraunhofer IIS We agree with ZTE. It is very premature to do a down-selection at this stage, given that we are going to have a SI first. We can identify the list of potential solutions later based on the outcome of the SI phase.

Proposed Objectives:

The Rel-18 NTN objectives are focused on the applicability of the solutions developed by general NR coverage enhancement to NTN, and identifying potential issues and enhancements if necessary, considering the NTN characteristics including large propagation delay and satellite movement. NTN-specific characteristics are to be included in this coverage enhancement work, otherwise it can be part of another WI (e.g., UL enhancement of coverage). The objectives need to cover the use case of voice and low-data rate services using commercial smartphones with more realistic assumptions on antenna gains, e.g., -5dBi instead of 0dBi typically assumed for link budget analysis for terrestrial networks.

- Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN [RAN1]

After conclusion of the evaluation above, the following candidate set of NTN-specific objectives, if needed, are listed. The candidate set of NTN-specific objectives may need to be updated/refined based on outcome of evaluation phase.

- Study, and if justified, specify repetitions enhancements beyond techniques covered in Rel-17 CovEnh WI for the relevant channels [RAN1]
- Study, and if justified, specify NTN-specific diversity techniques for the relevant channels [RAN1]
- [Improve the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead for VoNR] [RAN1,RAN2] [Liaise with SA2/SA4 as necessary]
    - NOTE: Intent is to optimize the RAN to work with the lowest rate codec currently available and will not introduce a new codec

Feedback Form 31: Coverage enhancements

1 – ZTE Corporation

Regarding the coverage enhancement, we should focus on the NTN-specific issues based on the evaluation firstly. Without detailed evaluation and requirements, it's premature to assume the benefits of certain solutions. To be more specific, regarding the 1st proposal under this topic, following updates are preferred:

- Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN **with following target services** [RAN1]
  - **VoIP service for commercial handset terminals.**
  - **eMBB service as first priority and VoIP as second priority for VSAT.**

Then, all other proposals can be removed and after the evaluation for specific service, enhancement cross all WGs can be considered based on the outputs.

Another point is that, we are fine to highlight the assumption of using commercial smartphones with more realistic assumptions on antenna gains and prefer to conlcude the value in the SI. Otherwise, potential example can be removed and details can be determined in WG.

2 – DOCOMO Communications Lab.

We have similar view with ZTE. No need to list the candidate solutions. Instead, the following text should be added.

- RAN to determine in RAN#XX whether there is to be specification support in Rel-18 or not.

3 – Guangdong OPPO Mobile Telecom.

For coverage enhancement, we suggest to put LEO 600 scenario as a higher priority.

4 – THALES

We agree with the Moderator's proposed set of objectives.

5 – vivo Mobile Communication Co.

Since we have to evaluate and identify coverage issue first, it is too early to narrow down the scope of potential enhancement areas. For the second bullet of candidate set, the meaning of NTN-specific diversity techniques needs further clarify. It should be noted that diversity transmission was left to implementation since NR Rel-15.

Suggest to revise the candidate set objectives as follows:

- Study, and if justified, specify NTN-specific techniques for the relevant channels that have coverage issues, e.g., repetitions enhancements, etc.

6 – MediaTek Inc.

We also think that coverage performance can be evaluated to identify the candidate channels that have coverage issues specific to NTN with following target services [RAN1] as suggested by ZTE.

- VoIP service for commercial handset terminals.

- eMBB service as first priority and VoIP as second priority for VSAT.

The objective on low-rate codecs in link budget limited situation with lowest rate currently available (as used in 3GPP with 4.75 kbps AMR being smallest data rate) with no new introduction of new codec can be prioritized. We think the study could be more focused.

7 – NOVAMINT

We are supportive of the moderator's proposed set of objectives.

8 – Intelsat

We support the moderator's proposal.

9 – HUGHES Network Systems Ltd

Agree with the Moderator's proposed set of objectives.

10 – Apple AB

11 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine with the proposed list of objectives

12 – Qualcomm Incorporated

We are OK with the set of proposals, but we would like to remove the square brackets around the voice subbullet. If companies are not convinced of the gains, we can add "Study and, if found beneficial, specify" to that bullet as well.

13 – Samsung Electronics Co.

We are fine with Moderator's proposal. We think the target satellite should include LEO/MEO/GEO all.

14 – LG Electronics Inc.

We also think there is no need to list the candidate solutions, since evaluation for the coverage performance identifying the channel having NTN-specific coverage issues should be done first. How to evaluate and which channels used for evaluation can be discussed evaluation methodology discussion in RAN1.

15 – KDDI Corporation

We agree with the Moderator's proposed set of objectives.

16 – Beijing Xiaomi Mobile Software

We are still not clear with the RAN1 impact on the RAN protocol overhead reduction. But if groups are fine with it, we can update as follows using the same wording with above two bullets:

[Study, and if justified, specify the improvement on the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead for VoNR] [RAN1,RAN2] [Liaise with SA2/SA4 as necessary]

17 – Asia Pacific Telecom co. Ltd

We support the proposals.

18 – HISPASAT SA

We are ok with the proposed candidates.

19 – ESA

We are fine with the proposed objectives.

20 – China Mobile Group Device Co.

Support the objectives other than the candidate solution.

21 – Ericsson LM

We are still of the opinion that breaking up the Coverage Enhancements work in different WIDs will not be optimal: it may lead to specifying different "flavors" of the same functionality for different uses, where a more unified approach might have been better. We should also reword a weak and ineffective statement: 1) "NTN-specific characteristics are to be included" -> "Only NTN-specific characteristics are to be included", and 2) "…otherwise it can be part of another WI…" -> "…otherwise it should be part of another WI…". Other aspects seem OK.

22 – CATT

Agree with Moderator's proposed set of objectives.

Due to some prior information of satellite moving, beam switching in low SNR can be enhanced with assisted information. And the beam switching in LEO is very frequent and rather weak in low SNR, so the motivation of improving beam switch in low SNR is clear.

So, we propose to add one more objective:

- **Study,andifjustified,specifyNTN-specifictechniques to enhance beam switching in low SNR case. [RAN1]**

23 – Nokia France

We agree with Ericsson.

If this objective is included here, the main bullet should be extended as follows, to avoid duplication of the work from Rel-17 and in the coverage enhancement topic in Rel-18:

Evaluate the coverage performance and identify the candidate channels that have coverage issues specific to NTN**, taking into account the studies in TR38.830 where appropriate, as well as general coverage enhancement techniques specified in Rel-18** [RAN1]

We agree with other companies that the list of candidate solutions is not needed.

Regarding the objective in square brackets, we believe that the RAN already works with the lowest available codecs, and hence the parenthetical sentence is not needed (also for the sake of keeping the scope down to a reasonable level).

24 – HUAWEI TECHNOLOGIES Co. Ltd.

We responded in the previous rounds that the coverage enhancement for NTN should be short andfocused considering: a) NTN is a potential RAN-2 leading item as per RAN#93e agreement, b) UL enhancement including coverage is discussed a dedicated topic in Rel-18. We are fine to evaluate some coverage enhancement specifically for NTN, but we do not think such evaluate should be too open and too general. We have below suggestion for revision:

1. The motivation for coverage enhancements comes from smartphone, we therefore suggest to explicit reflect it in the objectives and focus the evaluation on handheld devices only.

2. The proposals on the table are for uplink, so we suggest to focus the evaluation in uplink only.

3. Suggest to add few examples as listed in the justification part for issue specific to NTN, so there is no need to evaluate everything.

4. We agree with DOMOCO's proposal to set a deadline for such evaluation, so that there is no need to evaluate everything.

A revision for the evaluation part can be as follows:

Evaluate the coverage performance of **handheld devices** and identify the candidate **uplink** channels that have coverage issues specific to NTN **(e.g. large propagation delay and satellite movement)** [RAN1]

- **RAN to determine in RAN#97 whether there is to be specification support in Rel-18 or not**

For last bullet on "improvement of the performance of low-rate codecs", we have not seen any further feedback and our concerns still hold. We suggest to remove it unless its feasibility can be proven.

25 – Intel Corporation SAS

The first two objectives are fine for us.

There is no need to consider DMRS, CSI and packet interruption for Rel-18 from our perspective so RAN1 can focus on solutions for coverage issue to enable devices with lower antenna gain.

Considering the workload, we could remove this "low-rate codecs" enhancement. If it is kept, we suggest to only focus on "reducing RAN protocol overhead for VoNR", and exclude enhancements regarding other low-rate codecs.

26 – InterDigital

Supportive of Moderator proposal

27 – Fraunhofer IIS

As we repeated several times, we do not support any down selection of potential solutions at this stage. We agree with LG and ZTE.

3.1.1.2 NR-NTN deployment in above 10 GHz bands and support for VSAT NTN UE

As ESIM was listed as a possible deployment scenario and is covered by the harmonized Ka band frequency range in the way forward in RP-211596 and ESIM services can be supported by VSAT terminals, the moderator has removed ESIM as a UE class since it is not considered in TR 38.821 based on company feedback.

Based on Thales' feedback, the main bullet of "Study and identify NTN bands" was modified to remove the future proof protection of TN part. The aspects of note 3 of the approved way forward in RP-211596 are adequately covered in the second sub-bullet since note 3 was specific to implications of FDD. For the third sub-bullet, the moderator proposes to use similar language that was agreed for FR1 previously as a compromise to the language suggested by Ericsson in the initial round.

To ensure that the timing relationship enhancements are not restricted to k_offset only, the moderator has added e.g. prior to k_offset so that it is seen as an example and not a complete set.

Satellite BS aspects were added to the requirements definition objectives. The performance part objectives have been listed separately based on the Intel proposal as they need to be listed separately in the WID. The corresponding bullets have been removed from the core part.

Concerning the Ericsson request to add a bullet "RAN4 to take a look at the NTN bands above 10GHz and decide which "FR" properties they should be based upon, and make the requirements based on this.", the moderator would prefer to rely on the last sub-bullet "Definition of NTN band(s) above 10 GHz does not change the current FR1/FR2 definition, nor automatically apply to future terrestrial bands defined in this frequency region; (see proposal 2 of the approved way forward RP-211596 in RAN#92-e)" as being adequate to address this concern based on the outcome of the way forward in RP-211596. Similar language concerning "FR" properties was proposed previously and the compromise way forward was taken.

In addition, further clarification that new values for physical layer parameters on top of already defined values are not in scope was added based on Intel and Nokia comments.

Proposed Objectives:

The following assumptions are taken a baseline for this work:

- GEO and NGSO (e.g. LEO, MEO, HEO) based satellite access to be considered
- Targeted UE types: fixed and mobile VSAT. VSAT UE characteristics from TR38.821 to be considered in priority but additional NTN UE classes may be considered if justified
- FDD mode is assumed for satellite operation above 10 GHz, while TDD mode is assumed for terrestrial operation in FR2
- The harmonized Ka band frequency range (17.7-20.2 and 27.5-30.0) as common across all regions will serve as reference

The following covers the objectives for NR-NTN deployment in above 10 GHz bands.

- Study and identify NTN bands: Analysis of regulations and adjacent channel co-existence scenarios [RAN4]

- Consider at least a portion of the Ka band as the example band, according to ITU allocation; identify which parts of the Ka band are suitable as 3GPP bands [RAN4]
- Study implications of FDD operation in FR2 and derive requirements appropriately. Satellite bands introduced in 3GPP for NTN for FDD shall not impact the existing 3GPP TDD specifications for terrestrial bands (see note 3 of the approved way forward RP-211596 in RAN#92-e). [RAN4]
- Relevant coexistence scenarios and analysis to be considered in RAN4, if and where applicable, to ensure that satellite bands introduced in 3GPP for NTN shall neither impact the existing specifications of nor cause degradation (in the sense of RAN4 co-existence studies) to present and future networks in 3GPP specified terrestrial bands. [RAN4]
- Definition of NTN band(s) above 10 GHz does not change the current FR1/FR2 definition, nor automatically apply to future terrestrial bands defined in this frequency region; (see proposal 2 of the approved way forward RP-211596 in RAN#92-e) [RAN4]

– Specify Rx/Tx requirements for satellite BS and different VSAT~~/ESIM~~ UE class (not only 60 cm aperture) as appropriate for the identified example band [RAN4]

– Identify values for physical layer parameters such as time relationship related enhancement (e.g. K_offset), subcarrier spacing for different UL/DL signals/channels, PRACH configuration index for FDD above 10 GHz. Introduction of new values for physical layer parameters on top of already defined values is not in scope. [RAN1,RAN4]

Performance requirements:

– Specify RRM performance requirements and test cases [RAN4]

– Specify UE demodulation and CSI reporting requirements [RAN4]

– Specify BS demodulation requirements [RAN4]

– Specify BS conformance tests [RAN4]

Feedback Form 32: NR-NTN deployment in above 10 GHz bands

1 – ZTE Corporation We are fine with the details of this proposal.
2 – Intelsat We are ok with this proposal, however we would like to see ESIM kept in the following assumption, Targeted UE types: fixed and mobile VSAT. VSAT/**ESIM** UE characteristics from TR38.821 to be considered in priority but additional NTN UE classes may be considered if justified and the following objectives, Specify Rx/Tx requirements for satellite BS and different VSAT/**ESIM** UE class (not only 60 cm aperture) as appropriate for the identified example band [RAN4]
3 – Spreadtrum Communications We are supportive of the proposed objectives.

4 – DOCOMO Communications Lab.

We are fine with this proposal.

5 – THALES

In general we agree with the moderator's proposed objectives. However we propose to add "satellite" in relation to the BS as follow:

*"Specify **Satellite** BS demodulation requirements [RAN4]*

*Specify **Satellite** BS conformance tests [RAN4]"*

6 – T-Mobile USA Inc.

I do have one item of feedback for the NTN WID. In section 4 there is this:

- Relevant coexistence scenarios and analysis to be considered in RAN4, if and where applicable, to ensure that satellite bands introduced in 3GPP for NTN shall neither impact the existing specifications of nor cause degradation (in the sense of RAN4 co-existence studies) to present and future networks in 3GPP specified terrestrial bands. [RAN4]

It is not clear to me if this is precluding ITU Coexistence from being used. Indeed with the parenthetical, "(in the sense of RAN4 co-existence studies)" one could argue if RAN4 did not study it and conclude there was an impact, coexistence arguments could be ignored.

I would much rather see the bullet written as follows:

- Relevant coexistence scenarios and analysis ~~to~~ will be considered in RAN4, if and where applicable, to ensure that satellite bands introduced in 3GPP for NTN shall neither impact the existing specifications of nor cause degradation ~~(in the sense of RAN4 co-existence studies)~~ to present and future networks in 3GPP specified terrestrial bands. [RAN4]

7 – MediaTek Inc.

We are fine with moderator proposal

8 – NOVAMINT

We are generally supportive of the moderator's proposed set of objectives. We would agree with the changes proposed by Thales on adding "satellite" in relation to the BS.

9 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine with the proposal

10 – Qualcomm Incorporated

We agree with the objectives above.

11 – Samsung Electronics Co.

We are fine with Moderator's proposal.

12 – Beijing Xiaomi Mobile Software

We are generally fine with the objectives.

13 – Panasonic Corporation

We support moderator proposal.

14 – Asia Pacific Telecom co. Ltd

We are fine with the proposals.

15 – HISPASAT SA

We are ok with moderator's proposal and we are supportive of Intelsat and Thales' modifications.

16 – China Mobile Group Device Co.

Agree with the listed objectives.

17 – ESA

We are fine with moderator's proposal and we support the modifications suggested by Thales and Intelsat.

18 – Ericsson LM

ITU Radio Regulations (RR) supports besides mobile service (MS) also fixed satellite service (FSS) in the range 17.7-20.2 and 27.5-30.0. For actual MS usage band n257 (26.5-29.5 GHz) is a good example. FSS suggests usage of fixed VSAT. "Mobile VSAT" is a new term that needs to be properly introduced before used in a 3GPP WI, and should hence not be part of normative work in Rel-18. Our assumption is that Mobile VSAT is the same as ESIM. This needs clarification.

Concerning ESIM, sharing studies leading up to WRC-19 concluded that land ESIM and IMT is not possible to deploy in 27.5-29.5 GHz without geographical separation. Resolution 169 (referred to in ITU Radio Regulations note 5.517A) is consequently focused on the use of ESIM in maritime and aeronautical applications where sufficient distance from MS is provided. If mobile VSAT indeed is the same as ESIM then 3GPP may consider the use of mobile VSAT/ESIM in the range 29.5-30.0 GHz including adequate protection/guard band to band n257. This will require adjacent channel co-existence studies.

Concerning use of non-mobile FSS (i.e. VSAT) in the range 27.5-30.0, generic co-existence studies is needed to verify graceful coexistence with MS in band n257. In case earlier adequate work, e.g. performed by ITU, can be identified then 3GPPs work can build on those.

19 – CATT

We are fine with Moderator's proposal.

20 – Nokia France

The second sub-bullet of the objective should be clarified that it relates to the identified part(s) of the Ka band:

Study implications of FDD operation in FR2 and derive requirements for the identified part(s) of the Ka band appropriately.

Once again, we would highlight that this objective overall requires a huge amount of effort in RAN4, and appropriate TUs need to be allocated for it.

21 – HUAWEI TECHNOLOGIES Co. Ltd.

On the last bullet, we prefer to original version to make it more specific that no new SCS for a given signal/channel on top of already defined values is in scope. Hence we suggest to use Nokia's revision suggestion during the intermediate round

- Identify values for physical layer parameters such as time relationship related enhancement (e.g. K_offset), subcarrier spacing for different UL/DL signals/channels, PRACH configuration index for FDD above 10 GHz. Introduction of new ~~values for physical layer parameters~~ **SCS for a given signal/channel** on top of already defined values is not in scope. [RAN1,RAN4]

22 – Intel Corporation SAS

The objectives listed are fine for us.

As we commented out in previous round, NTN work in Rel-18 may have a potentially large scope in RAN4 including NR-NTN deployment in above 10 GHz and requirements for new Rel-18 features. Further prioritization of work can be required taking into account available RAN4 TU capacity.

23 – InterDigital

Supportive of Moderator proposal

24 – Fraunhofer IIS

We are supportive of the draft proposed by the moderator

25 – HUGHES Network Systems Ltd

In general we agree with the moderator's proposed objectives. However a few comments and proposed change:

In bullet and its 1st sub-bullet of objectives for NR-NTN deployment in above 10 GHz bands

- Consider at least a portion of the Ka band as the example band, according to ITU allocation; identify which parts of the Ka band are suitable as exemplary ~~3GPP~~ band~~s~~ [RAN4]

VSAT/ESIM was agreed in the WF RP-211596. We agreed with Intelsat to keep VSAT in the WID. Analysis of regulation will address its exact range for VSAT and ESIM in Ka-band

Agree with the proposed change by Thales.

3.1.1.3 NTN-TN and NTN-NTN mobility and service continuity enhancements

Many companies commented that RACH congestion could be removed based on previous RAN2 discussions around mitigating this issue. In addition, there was a suggestion to modify the item to “RACH-less HO”.

There was no consensus on the additional set of objectives that were proposed during the initial round and presented in the intermediate round. The moderator proposes to not discuss them anymore during the remaining email discussion and to focus on the list of objectives that are more stable.

The following objectives listed are based on items that are deemed to be relatively stable with the exception of the RACH topic which has been placed in brackets with the two different options. Please provide your views in the final round.

Proposed Objectives:

This work considers existing methods from NR TN as baseline for NTN-TN mobility as well as Rel-17 WI outcome and the further mobility enhancements objectives are listed below.

- Address handover interruption, handover signalling overhead [and {RACH congestion, RACH-less HO}] [RAN2,RAN1]
- Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements [RAN2,RAN4,RAN1]
- Consider RLF reduction issue for different delay and/or network topology between the different access types/points/nodes if justified [RAN2, RAN1]

Feedback Form 33: NTN-TN and NTN-NTN mobility and service continuity enhancements

1 – ZTE Corporation

Regarding the 1st bullet, it can be acceptable to remove the RACH congestion issue, but for the RACH-less HO, it can be considered if there is sufficient TU.

For the 2nd bullet, we prefer to focus on the NTN-NTN scenario. In NTN-TN, once the TN is available the UE will be attached to the TN always due to the better signal quality. Then, the following update is expected:

- Specify ~~NTN-TN and~~ NTN-NTN measurement/mobility and service continuity enhancements [RAN2,RAN4,RAN1]

For the 3rd bullet, we prefer to clarify the scenario since the various combination is covered by the existing bullet as: ”different delay and/or **network topology** between the different access **types/points/nodes** if justified”. In our view, we can focus on the changes between NSGO and NGSO based networks firstly. Then, the following update is expected:

- Consider RLF reduction issue for different delay and/or network topology between the different access types/points/nodes if justified [RAN2, RAN1]
- Notes: NGSO-NGSO scenario is prioritized.

2 – Intelsat

We are ok with the proposed objectives.

3 – DOCOMO Communications Lab.

OK with this proposal.

4 – Spreadtrum Communications

We are supportive of the proposed objectives.

5 – Guangdong OPPO Mobile Telecom.

fine with the proposal.

6 – THALES

We agree with the moderator's proposed objectives.

7 – vivo Mobile Communication Co.

As in previous rounds of comments, several companies are not clear about what bullet 3 actually means or intends to do (e.g. scenarios, issues to be solved, etc.). We also think it needs to be clarified; otherwise, we suggest to remove that bullet.

We are fine with the other parts of the proposed objectives.

8 – MediaTek Inc.

On first bullet, the need for RACH congestion and RACH-less HO is not clear and can be removed / de-prioritized

On 3rd bullet, it is needed to clarify the scope as scenarios seem almost unlimited and would have concern that RAN1, RAN2, RAN3 could spend a lot of efforts trying to clarify the scope and make priorities on the considered scenarios. We think NGSO-NGSO scenarios can be prioritized

9 – NOVAMINT

We are supportive of the moderator's proposed set of objectives.

10 – Apple AB

11 – HUGHES Network Systems Ltd

We are fine with the moderator's proposed set of objectives.

12 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

OK with the proposed objectives.

13 – Samsung Electronics Co.

We are fine with Moderator's proposal.

14 – LG Electronics Inc.

We are fine to proposed objectives

15 – Beijing Xiaomi Mobile Software

We are generally fine with the objectives

16 – Asia Pacific Telecom co. Ltd

We support the proposals,

17 – HISPASAT SA

Ok with this proposal.

18 – China Mobile Group Device Co.

Support the existing objectives. In addition, from our perspective, in some scenarios, the dual connection between the NTN and TN can benefit the performance of throughput, mobility signaling overhead reduction and cell load balancing, even for the UEs in the cell edge of TN network or the UEs equipped in UAV. If companies have concern on the workload of the WID, it can be de-prioritized rather than be excluded.

19 – ESA

We support the moderator's proposal

20 – Ericsson LM

We need to capture the fact that these are highly dependent on the architecture of choice. If we were to stay with the transparent architecture, we risk repeating the same discussions as for Rel-17. We should at least add "NOTE: if the same architecture is maintained as for Rel-17 (i.e. transparent architecture), these objectives will have low priority." Furthermore, for RLF reduction issue we may need to clarify "network topology between the different access types/points/nodes": are we referring to different constellations (GEO/…)? More in general, the objectives lack clarity. Also, before deciding to specify something, need, feasibility and impact must be considered.

21 – CATT

We support the objective, **besides that we propose to further work on some RAN3 leftovers, as below:**

- Specify the exchange of necessary information between gNBs to support TN-NTN mobility, decentralized case for feeder link switch. [RAN3]

22 – Nokia France

Among the RACH points, we do see the RACH congestion aspect being potentially important. As a possible way forward, RACH could be treated with second priority.

Also, as commented several times already, and also by other companies, the third bullet on "RLF reduction issue" is still unclear. As no clarification or definition of what exactly is the issue to be studied has been forthcoming, we cannot agree to this bullet and it should be removed.

23 – Intel Corporation SAS

In general we are fine with the proposed list of objectives. As we commented in the previous round we prefer to delete "for different delay and/or network topology between the different access types/points/nodes" for the third bullet since it doesn't add any useful information. And it's still vague what is "RLF reduction issue", we suggest to further clarify this issue for better understanding, or we could postpone it.

24 – HUAWEI TECHNOLOGIES Co. Ltd.

We would like to emphasize again that after multiple rounds of discussion, the proposed objectives are still quite vague and open ended. This will lead to a lot of confusion for WG discussions. In particular:

For objective 1, it is not clear what "Address handover interruption" really means. According to the feedback in the previous round, it seems that some companies have DAPS in mind. However, one should first clarify the target use case, e.g. traffic/services, which are sensitive to the handover interruption. Our understanding is that the motivation is not justified. For "handover signaling overhead", it is not clear what scenarios this is targeting. According to the feedback from some companies, we'd like to first understand whether this refers to group handover. If it is the case, this has already been considered in IAB Rel-18 discussion as pointed out by other companies and we don't see NTN-specific issues to be discussed here. One should avoid duplicating the work in two topics. So we do not think objective 1 is justified to be included in the WID.

For objective 2, we think there may need some enhancements but it is better to provide more details on which aspects need to be further enhanced.

In case of NTN-TN:

- Regarding measurements, the number of neighbor NT cells is massive in a large area covered by NTN. The major enhancements we foresee is to reduce UE power consumption by relaxing the measurements for TN where there is no neighbor NT cells for the UE. This at least applies to idle/inactive modes.
- For the handover, we think the R17 enhancements can be reused. We do not see any specific enhancements.

In case of NTN-NTN, we do not see any specific enhancements. We also don't see this whole bullet has any impact on RAN1.

Thus we suggest to update the objectives as below:

Specify NTN-TN ~~**and NTN-NTN**~~ measurement~~/**mobility and service continuity**~~ enhancements [RAN2,RAN4~~,RAN1~~]

- To optimize the measurement mechanism to indicate neighbor cell information to avoid unnecessary measurements in idle/inactive modes

For Objective 3, our question in the previous rounds remain unclarified and we'd like to repeat that as CHO is already supported, we don't see what specific enhancements are required. We observed that multiple companies expressed similiar view that the motivation of this objective is not justified. Given this bullet is not justified, we should not include this objective at this stage. Thus we suggest to remove this objective.

25 – InterDigital

Supportive of Moderator proposal

26 – Fraunhofer IIS

We are supportive of the draft proposed by the moderator

In addition, Apple suggested that NR NTN Evolution should consider supporting discontinuous coverage using IoT NTN work as baseline. Please provide your views in the final round if the following objective should be added.

- Consider supporting discontinuous coverage using IoT NTN work as baseline

Feedback Form 34: Consider supporting discontinuous coverage using IoT NTN work as baseline

1 – ZTE Corporation

We are not convinced to take the discontinuous coverage issue for eMBB usage in NR-NTN since better coverage should be the basic assumption to provide the eMBB service with a long connection.

2 – Intelsat

We are ok to consider discontinuous coverage using IoT NTN as a baseline.

3 – THALES

We are open to Apple's suggestion and consider supporting discontinuous coverage using IoT NTN work as baseline.

4 – Guangdong OPPO Mobile Telecom.

we don't think this is an urgent issue compared to other topics, e.g. CA/DC. We agree with ZTE's comment that the scenario is not favorable for eMBB usage.

5 – Eutelsat S.A.

This should be considered using IoT NTN as the baseline.

6 – NOVAMINT

We are open to consider discontinuous coverage using IoT NTN as a baseline.

7 – MediaTek Inc.

We see no need for this objective. NR NTN services are very different from IoT NTN services, and would most likle require much denser satellite constellation. It can be de-prioritized.

8 – HUGHES Network Systems Ltd

We are fine with Apple's suggestion to consider supporting discontinuous coverage using IoT NTN work as baseline

9 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are supportive to consider discontinuous coverage for NR NTN. It is expected to only require minimum efforts with IoT NTN works as baselines.

10 – Qualcomm Incorporated

In our view, support of discontinuous coverage is more useful in IoT scenarios. For eMBB, the use case is a bit more dubious.

11 – Samsung Electronics Co.

We are open to discuss, but this seems to be deprioritized.

12 – KDDI Corporation

We are ok to consider discontinuous coverage using IoT NTN as a baseline.

13 – HISPASAT SA

We are open to consider that proposal.

14 – Beijing Xiaomi Mobile Software

We don't think it is a prioritized topic for NTN. Our understanding on the support of discontinuous coverage is to save the power consumption which is more critical for IoT devices. We can include this topic for the IoT NTN WI if it is agreed to have a separate one.

15 – Asia Pacific Telecom co. Ltd

We are fine with the proposal.

16 – China Mobile Group Device Co.

It is acceptable to us.

17 – ESA

Fine to use the IoT NTN as a baseline.

18 – Ericsson LM

We propose rewording this item to "Considering current IoT NTN work as baseline, study whether such functionality is justified for NR NTN."

19 – CATT

Share the view with ZTE and some other companies, NR NTN is a wideband communication system, discontinuous coverage could not provide continuous eMBB services.

Thus, this is not the essential issue to be resolved, at least in Rel-18 NR NTN.

20 – Nokia France

We are open to include this.

21 – HUAWEI TECHNOLOGIES Co. Ltd. We agree with ZTE/OPPO/Qualcomm/CATT that discontinuous coverage is questionable for eMBB applications. We therefore suggest not to include this objective.
22 – Intel Corporation SAS In our understanding there is no need to introduce this bullet in Rel-18 NR NTN scope. After the corresponding work is done in IoT NTN this feature can be reused for NR NTN, if needed.
23 – InterDigital Support inclusion as objective
24 – Fraunhofer IIS We are supportive of the draft proposed by the moderator

3.1.1.4 Network based UE location

There are still competing views on whether this topic shall be handled as Study Item or a study phase as part of NTN Evolution WI. In addition, there are competing views on whether this topic shall be handled in NTN Evolution or Expanded and Improved Positioning. The moderator suggests leaving these competing views for further discussion at RAN#94e as there is unlikely to be any further way forward during the email discussion period.

There was general agreement that the proposed study item objectives were relatively stable. Slight modifications to the objectives were made based on company feedback to combine certain bullets and to study the necessary accuracy requirements. It is the moderator's understanding that the set of objectives imply that existing network-based positioning solutions are considered first and that enhancements are considered only if there are gaps identified. The specific bullet item concerning possible architecture enhancements was removed for now as there seemed to be general agreement to evaluate existing positioning methods applicable to NTN and adapt as necessary.

In the final round, please indicate if these objectives can be taken as the starting point for a Study Item or a study phase depending on the outcome at RAN#94e.

Proposed Objectives:

- Study detailed regulatory requirement for network-verified UE location, e.g. accuracy requirement.
- Study network-based positioning solutions suitable for NTN and identify achievable performance considering security and regulation requirements and considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2]
- Study and evaluate solutions for network to verify UE reported location information [RAN1,RAN2]
    - Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline
- Study possible issues of applying existing network-based positioning solutions in NTN and specify enhancements if needed. [RAN1,RAN2,RAN3]

Feedback Form 35: Network based UE location

1 – ZTE Corporation

It seems that in the current drafting, the discussion on the following two issues is mixed:

- Issue-1: Verification of UE reported GNSS location
- Issue-2: Define the standalone network-based positioning mechanism for the NTN system

In our view, based on the LS and regulation demand, it's clear that our main goal is to address issue-1 in Rel-18.

- Study detailed regulatory requirements for network-verified UE location, e.g. accuracy requirement.
- Study and evaluate solutions for network to verify UE reported location information [RAN1,RAN2]
  Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline

Then, once the fake GNSS reporting is identified at the network side, the service for such UE can be directly terminated.

For this part, the corresponding work (as SI phase) can be included in the NTN item directly, which is similar to the coverage enhancement part.

For issue-2, since the UE with GNSS is still the baseline in Rel-18, the corresponding study can be postponed later. Moreover, if the SI is needed, the following objective will be enough and the existing network-based method will be certainly evaluated during the SI phase.

- Study network-based positioning solutions suitable for NTN and identify achievable performance considering security and regulation requirements and considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2, **RAN3**]
  - **The existing network-based positioning solutions can be the baseline.**

2 – Intelsat

The proposed objectives are acceptable to us.

3 – DOCOMO Communications Lab.

We can accept current proposal direction. (But we think this topic should be included in pos SI/WI, which will be discussed in next RAN plenary as moderator said above.)

For study part, no need to say specify it. Instead, one text to decided at future RAN should be added.

- Study detailed regulatory requirement for network-verified UE location, e.g. accuracy requirement.
- Study network-based positioning solutions suitable for NTN and identify achievable performance considering security and regulation requirements and considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2]
- Study and evaluate solutions for network to verify UE reported location information [RAN1,RAN2]
  - Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline
- Study possible issues of applying existing network-based positioning solutions in NTN ~~**and specify enhancements if needed**~~. [RAN1,RAN2,RAN3]
- **RAN to determine in RAN#XX whether there is to be specification support in Rel-18 or not.**

4 – THALES

In general we agree with the moderator's proposed objectives. However we propose to modify one of the objectives as follow:

"Study network-based positioning solutions suitable for NTN and identify achievable performance considering ***privacy*** ~~***security***~~ *and regulation requirements and considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2]"*

5 – vivo Mobile Communication Co.

Considering the study areas, urgency and time budget, we fail to see the need to include network-based UE location in NR-NTN in Rel-18. In addition, this should be discussed under positioning SI/WI.

6 – MediaTek Inc.

This objective of study and specify network-based positioning expands the scope of this topic beyond verification of UE reported location. We are generally supportive of this objective but should be taken in a separate positioning WI with adequate TU allocations. We expect the impact on specifications to be significant. It should be first studied in a SI phase, and then discuss whether enhancements are needed and can be specified.

We are supportive of the objective in 3rd bullet on verification of UE reported location information with re-use of Rel-17 timing Advance report as baseline.

7 – NOVAMINT

We are supportive of the moderator's proposed objectives. We are ok with the change proposed by Thales on replacing "security" by "privacy".

8 – Apple AB

9 – HUGHES Network Systems Ltd

We are supportive of the moderator's proposed objectives.

10 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

We are fine with objectives 1, 2 and 4. However, we have concerns regarding objective 3. It is not clear to us what does "UE reported location information" mean. Are we assuming that UEs have GNSS capabilities? If so, then we need to clearly define it as baseline assumption. However, we are not supportive of it as main focus should be on network-based position irrespective of UEs have or do not have GNSS capabilities. Secondly, we would like to remove the sub-bullet "Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline" at this stage, as it requires further elaboration and also restricts to transparent payload. Furthermore, we believe that some architectural enhancements for NTN positioning may be needed (even in the case of transparent payload), so these need to be identified first during the study phase.

11 – Qualcomm Incorporated

We agree with the objectives above.

12 – LG Electronics Inc.

This topic should belong to Positioning SI/WI which will be discussed in RANp #94e as moderator.

13 – Samsung Electronics Co.

We think this can be done in Positioning enhancement WI.

14 – KDDI Corporation

In general we agree with the moderator's proposed objectives.

15 – HISPASAT SA

We are supportive of moderator's proposal. We strongly support objective 2 due to dependance on regulation requirements, as commented by ZTE.

16 – Beijing Xiaomi Mobile Software

We think there is some redundant information among the bullet, suggest to update as follows:

− Study detailed security and regulatory requirement for network-verified UE location, e.g. accuracy requirement.

− Study possible issues of applying existing network-based positioning solutions in NTN and specify enhancements if needed considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2, RAN3]

− Study and evaluate solutions for network to verify UE reported location information [RAN1,RAN2]

○ Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline

17 – Asia Pacific Telecom co. Ltd

We are OK with the proposals.

18 – China Mobile Group Device Co.

Fine with this.

19 – ESA

We are ok with moderator's proposal. Replacing security with privacy sounds better.

20 – Ericsson LM

As commented already, we would prefer to wait until the completion of relevant Rel-17 discussions (e.g. on ULI) before discussing network-verified UE location (subject to verifying whether there are shortcomings in the Rel-17 functionality). This could then be made into a dedicated SI, if needed.

21 – CATT

Generally, we're fine with the proposed objectives.

And we understand this should be done in a separate SI with independent TU allocation.

22 – Nokia France

We agree with the proposed objectives.

23 – HUAWEI TECHNOLOGIES Co. Ltd.

We would like to point out that it is only sensible to study on network-verified UE location solution if the detailed regulatory requirement for network-verified UE location, e.g. accuracy requirement, can be clearly identified. Otherwise, it is impossible to conclude whether the existing or new scheme can meet the requirement. So we suggest to set some deadline for Objective 1.

Study detailed regulatory requirement for network-verified UE location, e.g. accuracy requirement.

- Finish by RAN#xx

We share similar view as ZTE that objective 1 and 3 is sufficient for network-verified UE location. Objective 2 and 4 is not necessary for the mentioned requirement/target, so we suggest to remove objective 2 and 4.

- ~~Study network-based positioning solutions suitable for NTN and identify achievable performance considering security and regulation requirements and considering that the number of satellites in view can be limited (including single satellite) [RAN1,RAN2]~~
- ~~Study possible issues of applying existing network-based positioning solutions in NTN and specify enhancements if needed. [RAN1,RAN2,RAN3]~~

For objective 3, we are not sure "Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline" as it is not clear whether UE specific Timing advance report can be viewed as trusted from SA3. So we suggest to remove this sentence. ~~Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline~~

24 – Intel Corporation SAS

For "Study and evaluate solutions for network to verify UE reported location information [RAN1,RAN2]"As we commented in the previous round, it is not clear what is "UE reported location information". Generally speaking, network-based positioning is needed exactly to verify UE location by the network, so it seems redundant to include this bullet.

Also, in our view it doesn't make sense to consider Rel-17 UE-specific Timing Advance report as baseline solution to verify UE reported location information: reported TA can be also considered as UE reported location information.

So, we suggest to delete this bullet or clarify what is considered under UE reported location information.

25 – InterDigital

Supportive of Moderator proposal

26 – Fraunhofer IIS

We are supportive of the draft proposed by the moderator

3.1.1.5 Other comments for controversial topics identified in RP-211658

Companies provided additional views on the controversial topics identified in RP-211658. During previous discussion, many companies commented that MBS can be supported based on Rel-17 NR MBS and NR NTN without enhancements. Companies are encouraged to review the comments provided and consider them for future discussions.

The moderator categorized the topics as controversial since there were a significant number of companies that did not support handling these topics in Rel-18 during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions in order to maintain a manageable workload as such it would be difficult to include as stable objectives in any draft WID.

As the moderator indicated that no further discussion will be held on these topics prior to RAN#94e, there will be no additional feedback forms added in the final round for these topics. If companies would like to continue working towards consensus, proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions to work on possible compromise solutions prior to RAN#94e.

3.1.1.6 HAPS (High Altitude Platform System)

A feedback form was added in the intermediate round in order to provide companies a mechanism to collect additional viewpoints on HAPS. The intent of this feedback form was only to collect the input as part of the RAN94e Rel-18 Prep discussion. There is no intent to develop a way forward for this topic as an output of the NTN Evolution RAN94e Rel-18 Prep discussion based on the RAN Chair's guidance. Others are encouraged to review the comments provided and consider them for future discussions.

3.1.2 Evolution of IoT (Internet of Things) NTN

After consideration of all of the company input, the moderator has prepared a separate draft WID for Evolution of IoT NTN as there is no consensus to treat it in the same WID as Evolution of NR NTN given the different RAT.

Further de-scoping and prioritization may be needed to ensure RAN1 and RAN2 objectives can be completed with Rel-18 timeframe and TU budget allocation.

There were no objections to the responsible WGs and the potential interaction with SA/CT.

Please find the draft WID with the proposed justification and list of objectives based on the summaries for each topic below at https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5BRAN94e-R18Prep-13%5D/Draft%20RP-21xxxx%20WID%20IoT%20NTN%20Evolution.doc.

Please provide your feedback on the proposed justification section in section 3 of the draft WID as well as any comments outside of section 4 of the WID. The section 4 feedback will be captured in the feedback forms for each topic. The Final Round will be used to drive towards a final list of areas/objectives.

Feedback Form 36: Draft WID feedback on justification/others

1 – ZTE Corporation

For the Rel-18 related part in justification, we prefer to highlight the description on performance improvement below along with the 1st bullet.

- Improve performance in terms of throughput
- **Optimize the GNSS operation and power efficiency for long-term connection**

2 – Intelsat

We still feel that HAPS should be considered as a part of the NTN Rel-18 development. It was our understanding that while a separate SID for HAPS was not agreed it was not precluded the HAPS could be discussed in the context of NTN.

We would also like to emphasize our support for ”store and forward on-board NTN payload” in NTN IoT.

3 – THALES

We agree with the moderator's proposed justification in the draft WID.

4 – Eutelsat S.A.

We strongly support the addition of a ’Store-and-Forward’ feature for IoT-NTN.

Note: the term ’space segment’ in the last justification bullet should be removed to read: ”Further enhance the support of discontinuous coverage”.

5 – Eutelsat S.A.

Further to the above (comment #4) we would like to respond to the text in section 1.3.2.4. Our belief is that with the separation of the WIDs, and the difference between eNB and gNB technologies, the stated dependence of ’store-and-forward’ on NR-NTN is not applicable.

6 – MediaTek Inc.

Improve intra-NTN mobility is not needed as IoT NTN constellation are sparse and focus of companies is on discontinuous coverage. This would likely significantly increase the complexity of NB-IoT with divergence between legacy and NTN IoT devices, where legacy NB-IoT has basic mobility mechanisms to keep complexity low.

Optimize the GNSS operation with spare use of GNSS and power efficiency for long-term connection should be mentioned in justification

7 – HUGHES Network Systems Ltd

We support the moderator's proposed justification in the draft WID, with minor edits

- Improve ~~intra-NTN~~ mobility aspects
- Improve performance in terms of throughput
- Further enhance ~~the~~ support ~~of space segment providing~~ for discontinuous coverage

8 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

The justification in the draft WID is fine.

9 – Qualcomm Incorporated

Perhaps we could explicitly add ”Support longer connection times efficiently (compared to Rel-17)”

10 – Samsung Electronics Co.

We don’t think that improving mobility should be the main scope of a R18 NTN-IoT WID although it would be fine to have also some mobility enhancement if a WI is agreed. Thus improved intra-NTN mobility should be the last bullet in the list.

11 – Sateliot

We strongly support the addition of a store-and-forward feature for IoT NTN.

We agree with Eutelsat observation above that the store-and-forward topic is not dependent on the support of regenerative payload in NR-NTN evolution as indicated in 1.3.2.4. While it’s true that regenerative payload seems to be controversial for NR-NTN, we believe there is a much wider consensus on supporting regenerative payload with eNB/ng-eNB onboard architecture for IoT NTN.

Moreover, the workload of current IoT NTN WID proposal seems to remains quite manageable, as all included topics are fundamentally, optimizations of Rel-17 features. In addition, while we agree that adressing support for store-and-forward for IoT NTN may have an important impact on SA work, we believe the amount of work to be done at RAN level in terms of TU would be limited.

We would also like to express that the number of companies expressing concerns on this topic has been reduced since RAN93e Rel-18 Prep. Indeed, in the previous round in section 1.2.2.4, 12 out of 17 respondents have explicitly expressed support for the addition of this topic, 1 company remained neutral and 3 companies agreed to moderator suggestion of stopping further discussion on the topic prior to RAN#94e.

12 – NOVAMINT

We believe that there was a good and strong effort done in term of downsizing on the remaining objectives (assuming the further ongoing downsizing on mobility) and the justification reflects the objectives proposed.

However, one of the ambitions of the scoping for Rel-18 was to address the commercial perspectives and needs and we believe that typically the support of Store and forward for IoT NTN is already an immediate commercial needs as reflected by the fact that all Satellite operators have stated this as important. We also believe the effort on RAN would be limited and that a compromise to include a set of stable objectives is reachable so it would be possible to have still a reasonable package.

Therefore, we would highly appreciate if the moderator could reflect this aspect in his final conclusion as well as provide guidance on how to bring forward this additional objective (with clear limitation to this topic only) to or before RAN#94e assuming there would be enough consensus.

13 – Asia Pacific Telecom co. Ltd

We are fine with the justifications.

14 – HISPASAT SA

We agree with moderator's proposed wording, and strongly support the inclusion of store-and-forward feature as proposed by several partners.

15 – China Mobile Group Device Co.

We are ok about the proposed WID scope.

16 – Beijing Xiaomi Mobile Software

Generally fine with it, but the altitute range should be down to 300KM according to the definition of 36.763.

17 – HUAWEI TECHNOLOGIES Co. Ltd.

Agree with MediaTeK's comments that improvement of intra-NTN mobility is not needed. Mobility part is controversial according to moderator summary, we suggest to remove from the objectives and the justification

~~**Improve intra-NTN mobility**~~

The following bullet in the justification should be put in bracket since it depends on Rel-17 outcome.

[Further enhance the support of space segment providing discontinuous coverage**]**

18 – ESA

We are fine with the proposed WID, however taking into account the large support in the intermediate round on "Store and Forward" (12 out of 17), we do not consider this topic anymore controversial (Sec. 1.3.2.4). We support the inclusion of this topic in the final conclusions and guidance from the moderator.

19 – Ericsson LM

In general, the justification seems OK. We would propose rewording and simplifying the first sentence as follows: "In Release 17, a work item is carried out to enable NB-IoT and eMTC to support Non-Terrestrial Networks (NTN) under the following assumptions:".

20 – CATT

We agree with the comment# 2 from Intelsat and comment#4 from Eutelsat S.A.

And we think that "discontinuous coverage" and "mobility enhancement" is two independent topic for IoT NTN, we don't think we need to have the assumption of "discontinuous coverage" when we discuss "mobility enhancement".

21 – Gatehouse Satcom A/S

We are generally in agreement with the moderator's wording and WID proposal for IoT. We feel supported by many partners to **not** see "Store and Forward" as controversial, and trust that the moderator can take note of that in the final summary, as well guides how to proceed over the current suggested "offline discussion" in relation to this topic.

22 – HUGHES Network Systems Ltd

Additionally, noting the large support in the intermediate round for ”Store and Forward” (12 out of 17), we do not consider this topic anymore controversial (Sec. 1.3.2.4). We support the inclusion of this topic in the final conclusions and guidance from the moderator.

23 – Intel Corporation SAS

We are fine with the justification section in the draft WID provided by the moderator.

Rel-17 IoT NTN WI does not have any RAN4 scope and therefore baseline Core/Performance requirements are missing. So, we propose to remove all RAN4 Rel-18 objectives for now from the WID (performance part). Further discussion on how to handle basic IoT NTN RAN4 requirements shall take place before going with new Rel-18 RAN4 work.

24 – THALES

Given the strong interest from operators on the store and forward feature, it is important to include it in rel-18. May be the moderator can provide guidance on how to discuss further about its incorporation.

25 – Sony Europe B.V.

We think the justification needs to focus on achieving the 5G mMTC KPIs. The current justification doesn’t touch this (whether using the explicit ”5G mMTC KPI” wording or by discussing those KPIs implicitly). We hence think that there needs to be rethink on the justification.

3.1.2.1 IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

Based on the company input from the intermediate round, the majority support the objectives of Disabling of HARQ feedback and Improved GNSS operations. It is understood that any specific outcome of each objective is dependent on a demonstrated benefit. There was no convergence on the additional objectives that required further clarification other than the Improved GNSS operations objective. Based on the intermediate round comments, the further power savings enhancement was reworded to be more generic, and the PUR aspect was limited to NGSO. This particular objective was moved to the discontinuous coverage topic. The moderator recommends including these objectives in the draft WID as follows.

Proposed Objectives:

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1,RAN2]
- Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption [RAN1]

Feedback Form 37: IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

1 – ZTE Corporation

We are fine with the existing proposal.

2 – Intelsat We are ok with the objectives.
3 – Spreadtrum Communications We are fine with the proposal.
4 – THALES *We agree with the moderator's proposed objectives*
5 – NOVAMINT We are supportive of the moderator proposal.
6 – MediaTek Inc. We are supportive of the moderator proposal
7 – Apple AB We are OK with this.
8 – HUGHES Network Systems Ltd We are supportive of the moderator proposal
9 – Lenovo (Beijing) Ltd **Lenovo, Motorola Mobility:** OK with the proposed objectives.
10 – Qualcomm Incorporated We are OK with the objectives.
11 – Samsung Electronics Co. The moderator's proposal is fine.
12 – Beijing Xiaomi Mobile Software We are fine with the proposals
13 – Asia Pacific Telecom co. Ltd we are fine with the proposal.
14 – China Mobile Group Device Co. Support

15 – HUAWEI TECHNOLOGIES Co. Ltd.

We support to include disabling HARQ in the Rel-18.

Regarding improved GNSS operations for a new position fix for UE pre-compensation during long connection times, it is still not clear how it is different from what are being discussed in Rel-17 (see R1-2110645 section 2.5.2,). If this was specified in Rel-17, it is not clear what additional enhancement is needed in Rel-18. We suggest put this bullet in bracket and wait for Rel-17 progress.

□Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption [RAN1]□

16 – ESA

We are fine with the proposal

17 – Ericsson LM

For improving GNSS operations, it seems similar proposals are being discussed in Rel-17, so it seems better to wait for the outcome of Rel-17 before discussing this. For disabling HARQ feedback, the actual benefits of such a solution are still unclear to us. If this objective is to be included, we propose the following revision: "Study the benefits of disabling HARQ feedback and if found beneficial introduce disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates.

18 – CATT

We are fine with the moderator's proposed objectives.

19 – Gatehouse Satcom A/S

We are supportive of the moderator proposal.

20 – Nokia France

We are OK with this proposal.

21 – Intel Corporation SAS

For "Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption [RAN1]", considering that Rel-17 GNSS measurements are still under discussion it is not clear whether enhancements are needed. So, we suggest to add study phase for this objective in order to identify issues. In our view it is possible that Rel-17 design already works good without enhancements.

Thus, we propose either to delete this objective or add "Study and specify, if needed, …".

22 – InterDigital

Supportive of Moderator proposal

23 – Sony Europe B.V.

The objective on GNSS is OK.

Disabling HARQ feedback doesn't really improve data rate. If we wanted to improve data rate (which would be a good thing), why wouldn't we look at more effective solutions?

3.1.2.2 Mobility enhancements

The intermediate round discussions are starting to make this topic seem as if it is also controversial since there is not a consensus view on the specific set of objectives that are required for mobility enhancements for IoT NTN. Many companies supported the first set of moderator proposed objectives and commented about de-prioritizing the second set of proposed objectives. Others suggested de-prioritizing items from the first set of objectives. With the exception of "Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells [RAN1,RAN2]" which appears to have very little support, there were arguments made for the additional set of objectives from multiple companies.

The moderator proposes to list the full set of objectives for consideration in the final round as below in order to collect a full set of feedback so that all company views can be treated in the final round. Company feedback on specific modifications to each bullet and the relative priority levels for each bullet shall be provided so that a way forward for the list of objectives can be derived in the final round. The moderator will consolidate this input along with previously provided comments to develop this way forward.

Proposed Candidate List of Objectives:

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]
- Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]
- Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration [RAN1, RAN2]
- RACH congestion reduction [RAN2]
- Reduce handover signaling overhead [RAN2]
- IoT-NTN and TN mobility enhancement [RAN2]
- Beam-level mobility (Ncells with multiple anchor carriers) [RAN1, RAN2]

Feedback Form 38: Mobility enhancements

1 – ZTE Corporation

Regarding all bullets for mobility part:

- RACH congestion reduction: it can be up to the decision in NR-NTN, if this aspect is taken for NR-NTN, the corresponding solution can also be considered in IoT-NTN;
- IoT-NTN and TN mobility enhancement: This item can be deprioritized since, for IoT-NTN, the need for NTN-NTN mobility is marginal.
- Beam-level mobility (Ncells with multiple anchor carriers) [RAN1, RAN2]: We are open to this topic if there is sufficient TU.
- Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment: It seems that there is a potential overlapped discussion on the RRC reestablishment (for discontinuous coverage in next section). In this WI, we may need to highlight that a unified solution is expected.

2 – Intelsat

We support the proposed enhancements.

3 – Spreadtrum Communications

In our view, the following objectives can be prioritized:

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]
- Beam-level mobility (Ncells with multiple anchor carriers) [RAN1, RAN2]
- Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration [RAN1, RAN2]

4 – THALES

We consider that the following objectives should be prioritized:

· *Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17)*

· *NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration [RAN1, RAN2]*

· *Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]*

All other objectives can be de prioritized.

We agree with ZTE that for ”Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment”, there is a potential overlap with ”RRC reestablishment” (of discontinuous coverage in next section). In this WI, we may need to highlight that a unified solution is expected.

5 – Eutelsat S.A.

We support some of the candidate set with the following observations:

- Lower priority: Support of neighbor cell measurements...;
- Beam-level mobility requires further clarification/ justification;
- IoT-NTN and TN mobility enhancement - requires further clarification. e.g. Does this include cell and/or network (re)selection?

6 – MediaTek Inc.

- IoT NTN satellites are sparse constellation making it unlikely that CHO can be used, with companies focus being on discontinuous coverage. IoT NTN beamsizes can be 1000 km to 1700 km in diameter with up to 2 minutes in-satellite coverage.
- Need to consider Rel-17 NR NTN mechanisms (e.g. location-based CHO and timing-based CHO) for eMTC.
- Reduced handover signalling objective is un-clear and seems not needed. The occurrence of handover is not very likely.

- Beam level mobility with multiple anchor carriers can be de-prioritized. IoT NTN satellite will have 1 to 2 beams, and a maximum of 8 beams with large cells of 1000 km to 1700 km with UE in satellite coverage of typically 2 minutes. There may be 1 or 2 beam switches within that time. It is not needed to enhance the beam switches and would have significant impact on specifications and complexity
- RACH congestion was discussed in Rel-17 IoT NTN SI and there was no consensus that this was needed. Can be de-prioritized.
- IoT NTN and TN mobility enhancements can be de-prioritized. No clear need for this. Note that NB-IoT has very reduced mobility mechanisms in legacy cellular to keep complexity of device low. This kind of enhancements would significantly complexity and cost of IoT devices, and increase divergence between TN and NTN devices. Can be de-prioritized in Rel-18.

7 – Apple AB

We are OK with this.

8 – HUGHES Network Systems Ltd

We are in general OK with the proposal but ”Beam-level mobility” can be de-prioritized.

9 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

OK with the proposed candidate objectives. At least the first two bullets can be prioritized.

10 – Qualcomm Incorporated

We are OK with the list above. We would propose to prioritize beam level mobility.

11 – Samsung Electronics Co.

We think the last 4 topics can be deprioritized. RACH congestion reduction is not a priority in this early stage of NTN IoT development and is not related to mobility. Handover signaling overhead has not been identified as an issue. IoT-NTN and TN mobility enhancement is not a priority considering that such issue has not even been considered for NR NTN for which mobility is generally more important than for IoT devices. Beam level mobility enhancement seems also not a priority or at least it is not clear to us that there is a need.

12 – NOVAMINT

We believe the following items can be de-prioritized as there is no need and no clear justification especially for an IoT context:

- IoT-NTN and TN mobility enhancement
- Reduce handover signaling overhead

On RACH congestion reduction, this is not a mobility enhancement and not a priority so it can be de-prioritized.

On Beam-level mobility (Ncells with multiple anchor carriers), we believe there is not enough consensus at this stage for Rel-18 so it could be de-prioritized as well.

13 – NEC Corporation

We are not very clear why NB-IoT carrier selection is included in neighbor cell measurement and how it relates to mobility. It seems better to list the third item as two separate objectives.

And we believe issues below should be discussed in NR-NTN first and we can further consider the enhancement for IoT-NTN based on the solution for NR-NTN.

- RACH congestion reduction [RAN2]
- Reduce handover signaling overhead [RAN2]
- IoT-NTN and TN mobility enhancement [RAN2]

14 – Beijing Xiaomi Mobile Software

We think the following topics should be prioritized:

− Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]

− Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]

− Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration [RAN1, RAN2]

− IoT-NTN and TN mobility enhancement [RAN2]

While for the RACH congestion reduction and handover signaling overhead reduction, we think it is not a IoT-specific issue, and thus can be first studied in the NR NTN.

15 – Asia Pacific Telecom co. Ltd

We are OK with the objectives.

16 – China Mobile Group Device Co.

We are supportive of the objectives.

17 – HUAWEI TECHNOLOGIES Co. Ltd.

We agree with moderator conclusion that the entire area of mobility enhancements for IoT NTN is controversial. Our previous questions regarding these proposed objectives remain unanswered. We do not see any major issue with mobility as defined in R17 for IoT NTN. None of the proposed enhancements are essential and they could be all removed, so people can spend time on some other essential enhancements in other areas.

18 – ESA

We agree that several objectives can be de-prioritized. This would allow to reconsider ”Store and Forward”, which has a large consensus and very relevant market impact.

19 – Ericsson LM

This description is way too generic; it looks more like a list of objectives for a SI than for a WI.

20 – CATT

For the first objective, we understand it's pending to the progress of Rel-17:

And we think beam level mobility may have higher priority than IoT-NTN and TN mobility enhancement, we agree the view of Media Tek Inc. on IoT NTN and TN mobility enhancements.

For the 3rd objective, we understand the "carrier selection" is associated to coverage enhancement. Thus, we would clarify is that means the coverage enhancement will be introduced in Rel-18.

21 – Ericsson LM

More in detail. For location-based and timing-based CHO, if included it should at least be revised to indicate that this is about solutions introduced in Rel-17 NR NTN for mobility enhancements. Another question is what "can be considered" would mean? Up to RAN2 to decide whether those should be specified? If included as an objective it should provide a concrete message, e.g., "Solutions introduced in Rel-17 NR NTN for mobility enhancements (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]". On enhancements for RLF and RRC re-establishment, if it is included as an objective, it should then at least be formulated so that it is limited to the enhancements we introduce in Rel-17 for NB-IoT on RLF and RRC re-establishment: "Specify signaling for neighbor cell measurements and corresponding measurement triggering before RLF, to reduce the time taken to RRC reestablishment to another cell, without defining specific gaps. [RAN2, RAN4]." Furthermore, enhancements for paging carrier selection based on coverage level do not have anything to do with RLF and RRC re-establishment. RACH congestion reduction should not need anything more than is needed for NR NTN. The last 3 items are so generic it's really hard to understand what they actually mean.

22 – Gatehouse Satcom A/S

We agree that several objectives can be de-prioritized. We agree with ESA comment on to consider S&F due to high market relevance.

23 – Nokia France

We agree with Samsung that at least the last 4 bullets could be removed. They are all large and poorly scoped, requiring huge time commitment in the WGs. Moreover, beam-level mobility is not applicable in LTE-based systems.

Overall we think all these bullets are not sufficiently mature or clear for inclusion.

24 – Intel Corporation SAS

We would like to have a short list for necessary enhancements including:

- Solutions introduced in Rel-17 NR NTN can be considered (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]
- Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]
- Beam-level mobility (Ncells with multiple anchor carriers) [RAN1, RAN2]

and exclude others.

25 – InterDigital

Supportive of Moderator proposal

3.1.2.3 Further enhancement to discontinuous coverage

The intermediate round objectives and their dependency on the Rel-17 outcome were supported by the vast majority of companies. There did not seem to be a specific argument as to the necessity of listing an objective related to "Network-controlled mobility" when existing mobility is controlled by the network.

The "Enhancements in PSM timers requesting and configurations" sub-bullet was removed for now and will be revisited after the next RAN2 meeting. As noted earlier, the further power savings enhancements for IoT NTN to support discontinuous coverage was moved to this topic.

The list of objectives and their scope is highly dependent on the outcome of Rel-17. Further refinement of the list will be needed once the Rel-17 outcome is known. The moderator proposes the following list of objectives pending the Rel-17 outcome.

Proposed Objectives:

- Efficient power saving mechanisms (eDRX/PSM) for sparse satellite constellations [RAN2]
- Improvements to UE mobility among sparse cells [RAN2]
    - Enhancements in RRC reestablishment or recovery based on the discontinuity of coverage
- Further power saving enhancements for IoT NTN to support discontinuous coverage including PUR for NGSO (2nd priority) [RAN2]

Feedback Form 39: Further enhancement to discontinuous coverage

1 – ZTE Corporation We are fine with this proposal
2 – Intelsat We are ok with the proposed objectives.
3 – Spreadtrum Communications We are supportive of this proposal.
4 – THALES *We agree with the moderator's proposed objectives.*
5 – NOVAMINT We are supportive of the moderator proposal.
6 – Eutelsat S.A. We agree with the moderator proposal with following modification: *Efficient power saving mechanisms (**e.g.** eDRX/PSM) for sparse satellite constellations.*

Other power saving mechanisms should be considered. Due to this change we propose the moderator remove:

"Further power saving enhancements for IoT NTN to support discontinuous coverage including PUR for NGSO (2nd priority)";

as this is now covered by the previous point and we are not convinced of the practicality or benefit of PUR for NGSO cases.

7 – MediaTek Inc.

We are supportive of moderator proposal

8 – Apple AB

We are OK with this.

9 – HUGHES Network Systems Ltd

We agree with the moderator's proposed objectives

10 – Lenovo (Beijing) Ltd

Lenovo, Motorola Mobility:

OK with the proposed objectives.

11 – Qualcomm Incorporated

OK with proposed objectives.

12 – Samsung Electronics Co.

These topics, as the moderator summarized, depend on Rel-17 progress. We suggest to discuss them during RAN#94-e.

13 – HISPASAT SA

We support moderator's proposal and agree with Eutelsat's modifications on saving mechanisms.

14 – Beijing Xiaomi Mobile Software

Generally fine, but considering the workload, we think there is no need to list the topic that have a 2nd priority.

15 – Asia Pacific Telecom co. Ltd

We support the objectives.

16 – China Mobile Group Device Co.

We are ok to go for this.

17 – ESA

We support the moderator's proposal

18 – HUAWEI TECHNOLOGIES Co. Ltd. As summarized by moderator, the scope is highly dependent on Rel-17 outcome. so we suggest to discuss the scope once the Rel-17 outcome is known.
19 – Ericsson LM Given that these objectives are pending the conclusion of Rel-17, they are very generic. We should spell this out in a note: "NOTE: These objectives are highly dependent on the outcome of Rel-17, and they need to be re-evaluated once Rel-17 completes."
20 – CATT We are fine with the moderator proposal.
21 – Ericsson LM Furthermore, in more detail, considering that IoT connections are short lived, there is no need/motivation for this. Note that this could be even up to the (delay-tolerant) application layer protocols to handle.
22 – Gatehouse Satcom A/S We are supportive of the moderator proposal.
23 – Nokia France We agree with Samsung's comment.
24 – Intel Corporation SAS We can maintain the list and revise it after Nov WG meetings.
25 – InterDigital Supportive of Moderator proposal

3.1.2.4 Other comments for controversial topics identified in RP-211658

Companies provided additional views on the controversial topic of "Support for store-and-forward on-board NTN payload" identified in RP-211658. Companies are encouraged to review the comments provided and consider them for future discussions.

The moderator categorized this topic as controversial since there were a significant number of companies that did not support handling this topic in Rel-18 during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions in order to maintain a manageable workload. In addition, this topic is highly dependent on the support of regenerative payload which is a controversial topic in NR NTN Evolution. As such, it would be difficult to include a set of stable objectives in any draft WID.

As the moderator indicated that no further discussion will be held on this topic prior to RAN#94e, there will be no additional feedback forms added in the final round for this topic. If companies would like to continue working towards consensus, proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions to work on possible compromise solutions prior to RAN#94e.

4 Final Conclusions

Thanks to all companies for your valuable input during the 1-1/2 weeks of RAN#94 Rel-18 Prep email discussions. We made very good progress towards the goal of being able to approve the NTN Evolution aspects as part of the Rel-18 package in December. We don't yet have full consensus but the remaining efforts to come to consensus are limited. As an output of the discussion, two WIDs have been produced for NTN Evolution. One for NR NTN enhancements and one for IoT NTN enhancements based on the different RATs involved. In each WID, the moderator has provided a revision marked version to show the updates since the initial versions were produced based on the final round feedback as well as a clean version. There is no intent to repeat the same text for the justification and objectives from the WIDs in the final summary and conclusions section. Companies should refer to the WIDs for the latest proposed text from the moderator based on the outcome for each topic. It is expected that there will be required updates to the new/affected specifications at RAN#94e since there was no feedback provided on the initial proposals during the final round. The two WIDs can be found in the RAN#94e inbox at the following links.

New WI: NR NTN (Non-Terrestrial Networks) enhancements:

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/RP-212713.zip

New WID on IoT NTN (Non-Terrestrial Networks) enhancements:

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/RP-212729.zip

4.1 Evolution of NR NTN (Non-Terrestrial Networks)

For the justification and objective introduction section, there were several suggestions from ZTE, Intelsat, Thales, Hughes Network Systems, and Xiaomi that added clarifications, fixed Rel-17 aspects, and addressed the mobile VSAT equivalency. The moderator implemented these improvements with some modifications to align with the detailed objectives sections in the revised WID.

In addition, NTT DOCOMO proposed to add similar language as in the Rel-17 NTN concerning implicit compatibility to support HAPS (high altitude platform station) and ATG (air to ground) scenarios. A few companies supported this additional text but not all companies provided feedback given that this was not in the original moderator proposal. Given the late addition, the moderator has added this proposed text in brackets so that companies can provide further feedback at RAN#94e.

Concerning the Ericsson comment on the inclusion of the bullet for network verified UE location, the moderator has proposed to add the text "if needed based on the study outcome" as a way forward given the study objectives identified for this aspect.

The summary of the discussions and corresponding updates to the objectives for each topic are provided below.

4.1.1 Coverage enhancements

A number of companies are still concerned about listing candidate objectives prior to the evaluation stage. It is the moderator's understanding from all previous email discussions that the candidate set of objectives was reasonable based on company input (including some companies that are concerned with listing any candidate objectives now that the evaluation objective has been added). There is no intent to down-select potential solutions for the coverage enhancements based on the candidate set. Therefore, it seems valuable to list them

for the purpose of estimating TUs for the possible normative work for Rel-18 planning purposes. There is a statement that the candidate set of NTN-specific objectives may need to be updated/refined based on the outcome of evaluation phase and each candidate NTN-specific objective has a statement that it will only be specified if the NTN-specific objective is justified, where "is justified" means that RAN1 has identified shortcomings with currently used techniques in this scenario.

The Qualcomm clarification to the second candidate NTN-specific objective was preferred over the previous text by the majority of companies. In addition, the candidate objective concerning the performance of low-rate codecs was modified to remove the brackets based on adding similar language used for the other candidate objectives to study and to pursue only if justified.

Concerning the suggestion to apply different priority levels to different scenarios as proposed by OPPO, the moderator has the view that it is too early to discuss different priority levels to different scenarios. Priority levels or phasing of the work associated with different scenarios can be discussed at the working group level.

The clarification from ZTE (including the clarification from Apple) concerning the targeted services for the coverage enhancement evaluation stage was included in the revised WID. The "eMBB service as first priority and VoIP as second priority for VSAT" service was placed in brackets based on the Huawei comment to focus the evaluation for coverage enhancements on handheld devices only as much of the justification for coverage enhancements was targeted at commercial handsets from previous discussions. This aspect can be further discussed at RAN#94e.

The Ericsson and Nokia text to strengthen the statements concerning NTN-specific work and that any other coverage enhancements deemed to be outside of the scope are to be handled in the other coverage enhancements WI was adopted.

Concerning the need to add a timeline for the evaluation phase, the moderator has proposed text in the revised draft WID similar to the NTT DOCOMO text but modified as follows.

"RAN to determine by RAN#XX whether the evaluation stage has identified any need for NTN-specific coverage enhancements in Rel-18."

4.1.2 NR-NTN deployment in above 10 GHz bands

The proposed list of objectives was supported by the vast majority of the companies. Some improvements/clarifications were suggested and have been adopted in the revised WID.

The note added to the general objectives section that a "VSAT" device with external antenna on moving platform is equivalent to a device that operate on platforms in motion, and this is referred to as ESIM, applies to the entire objectives section. As such, this should resolve the device type comments concerning ESIM.

Concerning the T-Mobile comment to remove the parenthetical statement around RAN4 co-existence studies, the moderator would prefer to keep the already agreed language for FR1 as it is acceptable to the vast majority of the companies. The RAN4 co-existence studies have and can continue to take ITU studies into account.

The clarification from Nokia that the requirements would be developed for the identified part(s) of the Ka band was adopted. The proposal to replace 3GPP bands with exemplary bands from Hughes was not implemented to keep consistent language concerning example bands.

Intel proposed to clarify that the performance part objectives in the WID were specific to this topic. The moderator provided this clarification in the revised WID.

4.1.3 NTN-TN and NTN-NTN mobility and service continuity enhancements

Although a large number of companies supported the proposed objectives, there were still concerns on the RACH part and the third bullet on RLF reduction issue expressed by some companies. The moderator proposes to separate the RACH part into a separate bullet with second priority and to place both objectives in brackets to allow for further clarification/confirmation at RAN#94e.

ZTE and MediaTek proposed to prioritize the NGSO-NGSO scenario but there were no other comments on this prioritization proposal from others. The moderator proposes to leave the prioritization or phasing of the work associated with different scenarios to be discussed at the working group level unless there is a particular need to address this at RAN based on the overall Rel-18 scope and TU budget discussions.

The suggestions to remove either NTN-TN or NTN-NTN have not been considered in the revised WID as both mobility aspects have been discussed at length during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions. It seemed too late and controversial to remove either one at this point.

Proposals for additional objectives beyond the items identified in the final round have not been included in the revised WID.

The moderator has proposed to add "... based on confirmation of feasibility and impact ..." to the introductory text of the objectives to address the concerns expressed by Ericsson and Huawei. Hopefully, this can be considered a compromise to making significant modifications to the set of proposed objectives that are supported by the vast majority of companies.

Concerning the proposed additional objective from Apple to consider supporting discontinuous coverage using IoT NTN work as baseline, 14 companies were agreeable, 2 companies were open to discuss but de-prioritize, and 8 companies were against including the objective. Based on this outcome, this objective does not appear to be stable enough to include in the revised WID.

4.1.4 Network verified and Network based UE location

Concerning the study item objectives, the moderator has re-ordered them based on some of the comments from ZTE to separate the two issues. However, given that the Network verified location aspect would have to consider the assumption of GNSS-based positioning as well as Network based UE location if GNSS capabilities were augmented or compromised, it did not seem possible to completely decouple the two issues. The moderator has proposed updates to the study objectives in the revised WID.

Concerning the Lenovo comment related to the baseline assumptions, the general objectives section identifies that the assumption is UEs with GNSS capabilities. The restriction to transparent payload is also listed as one of the assumptions so keeping the sub-bullet "Re-use of Rel-17 UE-specific Timing Advance report can be considered as baseline" seems agreeable to most companies as it can be used to possibly limit the scope of the study. Others commented that the sub-bullet should be removed for now. The moderator's view from the discussion is that "can be considered" does not necessarily mean that it "will be" the baseline. This can be determined at the working group level at the beginning of the study.

The text related to specifying enhanced network-based positioning solutions in NTN was removed from the study objectives since specification work would be part of any work item. The moderator proposes to replace "specify enhancements" with "evaluate possible enhancements".

Concerning the need to add a timeline for the study, the moderator has proposed text in the revised draft WID similar to the NTT DOCOMO text but modified as follows.

"RAN to determine by RAN#XX whether the study has identified any need for Network verified and/or Network based UE location specification support in Rel-18."

4.2 Evolution of IoT (Internet of Things) NTN

For the justification section, similar updates were made to the set of Rel-17 assumptions as done in the NR NTN enhancements WID. In addition there were several suggestions from ZTE, Eutelsat, MediaTek, Hughes Network Systems, Qualcomm, and Ericsson that added further justification, simplification, and clarifications. The moderator implemented these improvements with some modifications to merge the suggestions. The list of justifications and objectives do not convey any priority order.

There was a suggestion from Sony to focus on achieving the 5G mMTC KPIs which was the last comment received on the justification section which did not allow any additional company feedback. The moderator did not include this aspect for now. If companies have a strong opinion of this aspect, please provide this input during the RAN#94e discussions.

Based on the Intel comment that the Rel-17 IoT NTN WI does not have any RAN4 scope and therefore baseline Core/Performance requirements are missing, the moderator has removed all of the RAN4 Rel-18 objectives for now from the WID (performance part). Further discussion on how to handle basic IoT NTN RAN4 requirements needs to take place before considering the new Rel-18 RAN4 work associated with this WID.

There were still many comments concerning the lack of an objective for Store and Forward capability. This topic does not seem to be stable enough to include in the WID to be presented at RAN#94e based on the overall company feedback during all Rel-18 discussions. The moderator did not perform number counting for supporting vs. non-supporting companies in each round based on the initial round guidance that compromise solutions should be presented for previously identified controversial topics and that companies should not repeat their comments from previous email discussions. It is the moderator's understanding that the company positions have not changed and there are not less companies objecting to this objective since they were not repeating their positions based on the guidance. The moderator considered the entire Rel-18 package discussion in order to determine if the set of areas/objectives were stable (or within reach of stable). Proponents are encouraged to work offline with companies that expressed concern during the RAN93e Rel-18 Prep and RAN94e Rel-18 Prep discussions when presenting possible solutions. If a compromise to include a set of stable objectives for Store and Forward is achievable, companies can submit alternate proposals assuming that there is consensus to agenda item 8A.5 per the RAN Chair guidance.

The summary of the discussions and corresponding updates to the objectives for each topic are provided below.

4.2.1 IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

There was general agreement on the list of objectives with the following comments.

As there is already Rel-17 work related to improving GNSS operations, the moderator has proposed additional text similar to other objectives in the NR NTN enhancements WID to add a statement to "Study and specify, if needed, ...". This should provide time to check the Rel-17 outcome and to address the justification of optimizing performance compared to Rel-17. There was vast support for the objective to improve GNSS operations in the final round. Hopefully, the additional modification can also be agreeable as it does not change the end goal if additional performance improvements over Rel-17 are needed.

There were concerns raised by Ericsson and Sony on disabling HARQ feedback. The moderator has left this

objective as is based on the level of support.

4.2.2 Mobility enhancements

Based on the comment from ZTE that there is potential overlap concerning RRC reestablishment enhancements proposed for mobility enhancements and further enhancement to discontinuous coverage, the moderator has added a note to both sections that a unified solution is expected.

Concerning the full list of objectives, the moderator provides the following summary of the outcome of the final round discussions.

Unfortunately, the NB-IoT carrier selection item was listed at the end of the neighbor cell measurements objective due to a typo (lack of carriage return). The moderator proposes to leave this item in brackets for now in order to allow for additional feedback at RAN#94e based on this issue.

The moderator assessed company input on which items needed to be prioritized and de-prioritized. As the comments from each company did not address every objective, the moderator took a lack of comment to de-prioritize as support for keeping the objective and a lack of comment to prioritize as an indication that the objective could be dropped. Two companies referred to deprioritizing some topics without specifics as to which topics in order to add the Store and Forward objective. Therefore, there was no ability to categorize their support/non-support for any of the existing objectives. The list of objectives is listed in the order of support with the number of companies supporting out of 22 companies where input could be categorized.

- **(17 companies)** Enhancements on RLF and RRC reestablishment, e.g. conditional RRC reestablishment. [RAN2]
- **(16 companies)** Support of neighbor cell measurements and corresponding measurement triggering before RLF. This may include legacy (Rel-17) [RAN2].
- **(14 companies)** Solutions introduced in Rel-17 NR NTN for mobility enhancements (e.g. location-based CHO and timing-based CHO) for eMTC [RAN2]
- [NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration] [RAN1, RAN2]
- **(12 companies)** Beam-level mobility (Ncells with multiple anchor carriers) [RAN1, RAN2]
- **(10 companies)** RACH congestion reduction [RAN2]
- **(10 companies)** Reduce handover signaling overhead [RAN2]
- **(7 companies)** IoT-NTN and TN mobility enhancement [RAN2]

In this case, the top three objectives matched the moderator proposal prior to the intermediate round. The moderator proposes to keep the three objectives proposed prior to the intermediate round and confirmed based on the final round prioritization effort. The moderator proposes to remove the remaining items from the list of objectives with the exception of keeping the NB-IoT carrier selection item in brackets due to the typo issue.

Ericsson has proposed to modify the RLF and RRC reestablishment objective as follows.

- Specify signaling for neighbor cell measurements and corresponding measurement triggering before RLF, to reduce the time taken to RRC reestablishment to another cell, without defining specific gaps. [RAN2, RAN4]

The moderator recommends discussing this clarification at RAN#94e prior to updating the WID to collect additional feedback. For now, the objective text will remain as is.

4.2.3 Further enhancement to discontinuous coverage

The existing list of objectives seemed acceptable with a comment from two companies that PUR for NGSO should be removed. Eutelsat suggested to treat eDRX/PSM as examples and not to preclude other power saving mechanisms. The moderator has added text to treat eDRX/PSM as examples and proposes to add brackets to the PUR for NGSO second priority objective for now so that it can be further discussed at RAN#94e.

Concerning the Ericsson comment to add a note to the WID that the objectives are highly dependent on the outcome of Rel-17 and they need to be re-evaluated once Rel-17 completes, the moderator view is that the introductory clause to 4.1.3 in the WID conveys the same information.