

RAN93e-R18Prep-08 - Version 0.0.5

RAN

3GPP TSG RAN Meeting #93-e

RP-211658

Electronic Meeting, September 13 - 17, 2021

Agenda Item: 9.0.1

Source: RAN Vice-Chair (AT&T)

Title: Moderator's summary for discussion [RAN93e-R18Prep-08] NTN evolution

Document for: Information & Decision

The discussion in this thread covers the topic #8 [RWS-210659]

“**NTN (Non-Terrestrial Networks) evolution** - Including both NR & IoT (Internet of Things) aspects”

Deadlines and NWM organization based on the guidelines provided by the RAN Chair in [RP-211639].

As per guidance [RWS-210659] of the RAN Chair, the discussion in this thread should be based on the (RAN REL-18 workshop) RWS submissions!

The aim is to converge on a set of areas with a reasonable scope as a “high-level description” – where “high-level description” herein is not a “draft SID/WID” but is something like a single slide with a set of bullets. In other words, it can be viewed as a skeleton of the possible objectives with some high-level notes.

Please avoid any input like “We support / we do not support” as this is not a “number counting” driven discussion but focus on tangible commercial interests (both near & long term).

1 Initial Round

1.1 Collection of company views

1) General high-level views

Feedback Form 1: General high-level views

1 – Nokia France

Across all the contributions in the workshop, a very wide and diverse set of different enhancements (>30) was suggested for NTN and IoT-NTN by different companies. It is clear that careful prioritisation and selection is needed, to focus on a small but genuinely useful set of enhancements.

2 – THALES

I. RAN to consider the creation of a **Rel-18 work item eNR-NTN** with the following candidate enhancements listed above (grouped according to the category of benefits):

I.1 Candidate features for performance optimization enhancements:

- § Coverage enhancement (especially to address commercial smartphones)
- § DL PAPR reduction
- § NTN-TN and NTN-NTN mobility and service continuity enhancements
- § NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation

They may impact

- *Throughput per UE, network throughput efficiency, signaling overhead*
- *UE power saving, service continuity, availability and reliability*

I.2 Candidate features for new capabilities enhancements:

- § NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE
- § Support of MBS
- § Network based UE location
- § UE without GNSS (Study phase only)

They may impact

- *regulatory compliance*
- *new bands*
- *new services*

II. RAN to consider the creation of a **Rel-18 work item eIoT-NTN** with the following candidate enhancements listed above (grouped according to the category of benefits)

II.1 Candidate features for performance enhancements:

- § Mobility enhancements
- § Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN

They may impact

- *network throughput efficiency, signaling overhead*
- *UE power saving, radio link failure, availability and reliability*

II.2 Candidate features for new capabilities enhancements:

- § Support for store-and-forward on-board NTN payload
- § IoT-NTN deployment in new bands (e.g. L band) (note that this activity can be carried out as part of a release independent work item) after March 2022

They may impact

- *Regulatory compliance*
- *New bands*
- *New services*

3 – Intelsat

Intelsat Supports Thales' response.

In particular we strongly support,

- DL PAPR reduction (e.g. DL DFT-S-OFDM)
- NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE
- Support of MBS
- Network based UE location
- UE without GNSS
- Coverage enhancement (especially to address commercial smartphones)
- NTN-TN and NTN-NTN mobility and service continuity enhancements

We also support the creation of a Rel-18 work item eIoT-NTN including,

- Mobility enhancements
- Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN
- Support for store-and-forward on-board NTN payload

In addition we consider the following to be of interest for NTN, and HAPS,

- Regenerative Payloads

While it is understood that a specific payload architecture has not been decided, we believe the investigation of regenerative payloads is very desirable. A few such architectures may include vRAN, CU/DU split, and O-RAN.

4 – Qualcomm Incorporated

The evolution of both NTN technologies (IOT and NR) should build upon the foundation of Rel-17, without introducing major non-compatible changes.

5 – Apple Poland Sp. z.o.o.

We see the following items in Rel-18 as important to solve.

a. Non GNSS operation : R17 NTN assumes UE has GNSS capability. However, UE may not always receive GNSS signals due to feature such as power savings, measurement gaps and infeasibility of signal itself. In this regards, enhancements related to UL synchronization in both RRC Idle and Connected modes become necessary.

b. Regenerative mode satellites : In R17 NTN focussed only on transparent mode. However, future NTN deployments seem to be pointing to regenerative satellites (in different configurations) which are highly desirable in terms of the reduced latency. Some enhancements related to time and frequency synchronization become necessary for R18 to support regenerative mode.

c. NTN-TN and vice-versa mobility: The treatment of mobility handling between TN and NTN has been minimal at best in R17. We wish to ensure that TN-NTN mobility can be treated further in terms of ensuring optimizations to the mobility procedures and potentially deal with CA, DC scenarios. Also regenerative

mode will add in additional complexities and advantages both of which need consideration in terms of NTN-TN handovers.

d. Support of discontinuous coverage for NB-IoT NTN: Due to the sparse initial deployments of satellite configuration in both space and time, extensions will be needed to the discontinuous coverage scenarios started in R17

6 – Guangdong OPPO Mobile Telecom.

For Rel-17 NR-NTN, GNSS-based handheld terminals under the scenario of transparent satellites are mainly discussed. Some identified issues, e.g., associated BWP and beam to operate in an efficient way, enhanced beam measurement/management, coverage enhancement to support smart devices, etc., may not be specified in this release due to lack of time.

For Rel-17 IoT-NTN, it mainly targets for sporadic short transmission under standalone mode and very basic features are supported. We think that further improvements on the system throughput/efficiency would be needed. Besides, eMTC over NTN may be risky not to be completed due to very limited time in Rel-17 (still pending decision from September's RAN plenary meeting).

In general, we think it is important to have a continuing WI for both NR-NTN and IoT-NTN in Rel-18.

7 – China Mobile Group Device Co.

According to workshop contributions, in addition to the R17 leftovers about both NTN and IoT-NTN, some new enhancements are provided, for example, regenerative payload, UE without GNSS, spectrum sharing, coverage enhancement, power saving (mainly for IoT-NTN), TN-NTN co-ordination, etc. Then, from our perspective, at least the following need to be discuss firstly:

- *UE without GNSS for both NTN and IoT-NTN*
- *mobility enhancements for intra-NTN and NTN-TN*
- *spectrum sharing*
- *power saving for IoT-NTN*
- *R17 leftovers*

8 – Spreadtrum Communications

We share the observation with Nokia on R18 WS for NTN.

For R18 NTN, from SPRD's view, we should focus on those genuinely useful set of candidate enhancements.

9 – CATT

From the previous workshop, more than 20 companies took participated in the discussion and provided over 20 (even >30) enhancements or new functionalities for Rel-18 NR NTN and IoT NTN.

Obviously, the scope is too large to be finished in Rel-18.

Therefore, we need to narrow-down the scope for Rel-18 NTN evolution. Maybe we could just focus on the necessary enhancements and new functionalities with some real commercial requirements in Rel-18.

10 – Beijing Xiaomi Mobile Software

The essential design for enabling satellite communication is specified for VSAT/handheld/IoT devices in Rel-17. In Rel-18, we see a need to continue the standard work to support the enhanced performance from the following aspects.

One aspect is to enhance the performance such as support higher UE's data rate, coverage enhancement for smart phone, mobility enhancement and power saving enhancements for IoT devices. The other one aspect is to support new capabilities such as network based positioning and other potential areas.

11 – DOCOMO Communications Lab.

Large scope is not preferable. Limited number of objectives should be included in Rel-18 NTN.

On HAPS, careful and sufficient clarification on HAPS support for each objective should be done. We think that this was not enough in Rel-17 NTN. Note that this is necessary regardless of SI/WI structure between NTN and HAPS since some features for NTN (satellite) are shared with HAPS NW without any enh., but other features are not. Without this clarification, the same situation is assumed, i.e. whether each feature is available in HAPS NW as it is or not is unclear.

12 – Ericsson LM

Use cases for both IoT-NTN and NR-NTN foresee a growing market, and in order to be able to scale for such growth we believe that the Rel-17 transparent architecture is not adequate. We therefore support regenerative architecture in Rel-18. Among those already studied by RAN3, we think the most promising one is the one based on the full gNB on board the satellite: it provides better capacity and scalability, it ensures a good level of flexibility for gNB implementations, and it unlocks the possibility to use Xn for inter-satellite links, thereby enabling features such as inter-satellite mobility, DC, and resource coordination leveraging currently specified functionality.

13 – Gatehouse Satcom A/S

Gatehouse's does support the candidate responses of THALES and INTELSAT.

It is important to distinguish between functionality that builds on the Rel-17 fundament of NTN functionality for NR and IoT, with purpose for optimization/performance, or adding functionality.

For NR-NTN:

- Coverage enhancement
- DL PAPR reduction
- NTN-TN and NTN-NTN mobility and service continuity enhancements
- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Regenerative Payload
- Support of MBS
- Network based UE location

For IoT-NTN :

- Support for store-and-forward on-board NTN payload
- Mobility enhancements
- Preconfigured Uplink Resource
- Further enhancement to discontinuous coverage

14 – SoftBank Corp.

Our view on HAPS is provided to email discussion#15. Some of the scope may be common with satellite in NTN, but we assume that the discussion how to merge (or keep separated) will be done at the later stage.

15 – Lenovo (Beijing) Ltd

Rel-17 NTN is the first workable version of NTN, and Rel-18 NTN should focus on enhancements for optimizing performance and enabling new capabilities for a wider commercial market. Rel-18 NTN is expected to address commercial use cases such as support for:

- mobile handheld devices such as smart phones,
- various verticals such as Redcap UE,
- various types of traffic such as MBS, especially in recovery from disaster,
- etc.

Meanwhile, NR NTN and IoT NTN were specified in Rel-17 with UE restrictions such as GNSS capability. Such restrictions are expected to be eased hence allowing Rel-18 NTN to support a wider range of UE capabilities and use cases. NR NTN and IoT NTN may continue to have separate study/work items as they are in Rel-17.

16 – Asia Pacific Telecom co. Ltd

R-18 improvements on NTN could be discussed based on the following aspects:

- Service level, such as introducing & adapting new service or existing 3GPP services over NTN.
- Network level, such as NTN enhancements or NTN-TN interworking issue.
- Resource level, such as possible new physical resources to be accessed by NTN.
- UE level, such as IoT UE/smartphone UE/RedCap UE. To reduce the loading of WI, common mechanisms may be developed as a baseline and then we can discuss whether/how to apply the mechanisms to different types of UEs.

17 – NOVAMINT

We share the views from many that it is important to have a continuing WIs for both NR-NTN and IoT-NTN in Rel-18 while having reasonable scope driven by real commercial requirements.

For IoT-NTN, we need as well to take into account that only a limited effort was possible in release 17 so there would be leftovers and enhancements needed.

We also share the views from Apple, Ericsson and others that transparent architecture as supported in release 17 is not enough and we should support regenerative architecture in Rel-18.

In this context, we agree with the approach and priorities listed by Thales, Intelsat, Gatehouse as it reflects all of the above and in particular real commercial needs and a reasonable scope should be the following:

NR NTN:

- Coverage enhancement (especially to address commercial smartphones)
- NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE
- DL PAPR reduction
- NTN-TN and NTN-NTN mobility and service continuity enhancements
- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Support of MBS
- Network based UE location
- + UE without GNSS (study phase only)

IoT-NTN:

- Support for store-and-forward on-board NTN payload in association with discontinuous coverage to have further cost effective and scalable solutions adopted by the market
- Mobility enhancements including Beam-based mobility / Multiple satellite beams in one cell
- Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN in association with discontinuous coverage
- + Release independent work item for the definition of new bands for IoT-NTN

18 – VODAFONE Group Plc

We share the observations from Nokia and Spreadtrum: we should focus on a very small number of genuinely useful enhancements.

For IoT-NTN, enhancement for discontinuous coverage may be useful.

19 – Intel Corporation SAS

In our view Rel. 18 work on NTN should be focused on aspects enabling important use-cases for 3GPP-based NTN deployments. In particular, we think that enhancements for NR FR1 NTN with smartphone UE should be considered.

The focus should be in essential enhancements or new features which require minimal standardization efforts. One feature which has been considered by some companies at the 3GPP RAN Rel-18 workshop is support of UEs without GNSS. In our view support of UEs without GNSS is not sufficiently well motivated to be included in the Rel-18 NTN.

20 – Panasonic Corporation

We support the following candidate enhancements on NR-NTN.

- Regenerative payload
- UE without GNSS (with Network based UE location)
- NR-NTN above 10 GHz
- High performance UE
- DL PAPR reduction

21 – FirstNet

RAN should consider a Rel-18 work item eNR-NTN with the following enhancements:

- o Coverage enhancement (especially for commercial smartphones)
- o NTN-TN and NTN-NTN mobility and service continuity enhancements
- o Support of MBS

22 – HISPASAT SA

As many, we support continuing the efforts in NTN for NR and IoT, following commercial requirements and prioritizations.

Hispasat does agree with Thales, Intelsat, Gatehouse, Novamint that following candidate items should be covered in Rel-18 WIs for both eNR-NTN and eIoT-NTN:

For eNT-NTN we strongly support:

- Coverage enhancement (specially to address commercial smartphones)
- DL PAPR reduction (e.g. DL DFT-S-OFDM)
- NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE
- Support of MBS
- Network based UE location
- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- NTN-TN and NTN-NTN mobility and service continuity enhancements
- Study on UE without GNSS

Regarding IoT, we also support the creation of a Rel-18 work item **eIoT-NTN** focusing on performance enhancements. Agree with Vodafone that discontinuous coverage should also be considered, with different enhancements needed for NTN IoT.

- Mobility enhancements
- Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN
- Support for store-and-forward on-board NTN payload
- Support for IoT-NTN deployment in new bands

23 – ZTE Corporation

We are in general supportive for the continuous enhancement on both NR- and IoT-NTN to boost the 5G application. However, these two topics should be separately discussed with controllable scope. For IoT part, we need to focus on remaining issues which is missing in Rel-17 due to limited time and for NR-NTN, further extension can be considered to enable more use cases.

24 – Sateliot

Rel-17 is expected to set the basis for a minimum IoT NTN working solution for pre-commercial trials and early commercial deployments. This is expected to be a key milestone and strong message to the industry that the 3GPP community is committed to deliver global solutions for the massive satellite IoT market and help mitigate technology selection risk and fragmentation.

Rel-18 shall necessarily continue such a path, with the addition of the necessary performance enhancements and new capabilities to further position and strengthen the role of 3GPP technologies in this market.

Sateliot's supports Thales propositions above, especially the creation of one WI on eIoT-NTN at RAN level including:

- Support for store-and-forward operation with on-board NTN payload
- Mobility enhancements for multi-beam/cell IoT satellites
- Access optimization (e.g. Preconfigured Uplink Resource support) and further power saving enhancements for IoT NTN

In addition, Sateliot's supports the creation of a Release independent WI for the definition of new bands for IoT-NTN.

Also essential is the coordination with TSG-SA/TSG-CT to ensure that necessary work on IoT-NTN is planned in relevant SA/CT groups to define some of the enhancements. In particular, the following two capabilities are impacting both RAN and CN work and shall be addressed coordinately at system/architecture optimization level:

- Support for store-and-forward operation. This may have architectural impacts and needs enhancements to support store and forward IoT services (e.g. network functional splits, enhancements to cope with moving RAN nodes, support of decoupled signaling procedures "UE <-> Satellite" and "Satellite < CN ground" for achieving end-to-end functionality).
- Support of discontinuous coverage (while support for discontinuous coverage is being already added under Rel-17, this is mainly at RAN level and with minimum expected impact on CN specifications. However, we believe that a further study is required for such feature at SA2 level which may result in further improvements needed at both CN and RAN specifications).

We would also support the realization of a study about supporting UE without GNSS, which reduce dependency to GNSS service availability in lower cost UEs.

25 – MediaTek Inc.

Distinct and careful scoping of NR-NTN and IoT-NTN is required in Rel-18 - with strict evolution required for both, bearing in mind Rel-17 focused primarily on key technology enablers for satellite use of NR, NB-IoT and LTE-M.

It is also important to start addressing **spectrum reuse between NTN and TN** as a means for MNOs, using their own spectrum assets, to reach into areas otherwise unreachable with traditional TN means.

26 – InterDigital

As mentioned by other companies, careful scoping is necessary. We think the focus of this WI should be on refining the existing deployment scenarios (e.g. transparent LEO/GEO) to increase support for devices with varying capability and seamless integration between TN and NTN. We suggest that adoption of additional deployment scenarios (e.g. regenerative satellites or ISL) be down prioritized in this release.

27 – Samsung Electronics Co.

In Rel-17 NTN, standardization is being done with assumption of transparent payload for satellites and active GNSS capability for UEs. Also, it is assumed that the entire LEO constellation is already available. We suggests the following enhancements on NTN support in Rel-18 to enlarge the application areas that can take benefit of NTN.

- Regenerative payload and Inter-satellite link (ISL)
- Multi-connectivity
- Leftovers that are not included in Rel-17 and supporting UE without GNSS capability

28 – Classon Consulting

For FUTUREWEI

We would prefer to see a small number of impactful objectives rather than a big list of small enhancements. It is OK (and perhaps expected) that these sort of objectives may require study first. The proposed enhancement with the biggest potential benefit appears to be enabling ISL via regenerative payloads. We are less interested in "redoing Rel-17" for operation without GNSS. It may be OK to focus on NTN rather than NTN-IoT in Rel-18.

29 – KDDI Corporation

We agree with Docomo and Softbank. Basically, the scope of study in Rel-18 should be minimized and currently raised candidate enhancements seems to be so many.

We support to study development on both scenarios HAPS and NTN (satellite) in Rel-18 and discuss whether to merge or how to merge two scenarios at the later stage.

30 – HUAWEI TECHNOLOGIES Co. Ltd.

- Rel-18 NTN should focus on deployment scenarios and use cases that can provide tangible commercial opportunities.
- Prioritize features that can leverage the existing 5G NR system design and ecosystem, e.g. avoid fundamental changes to basic system designs such as initial access
- Prioritize features that can provide or enhance service availability to areas where there is no terrestrial network coverage
- Prioritize features that have practical performance improvement and smaller specification impact
- Prioritize Rel-17 leftovers such as beam management enhancements considering the characteristic of satellite beams

31 – Fraunhofer IIS

According to Fraunhofers' view, we see in general two different classes of use case possible and beneficial for satellite integration:

1. High and medium throughput (NR based) to special types of terminals below and above 10 GHz
2. Low and medium throughput (LTE IoT based)

In our opinion, the following enhancements are crucial in the displayed order of priority for supporting these two clusters of use cases:

High and medium throughput (NR based) to special types of terminals below and above 10 GHz:

- DL PAPR reduction
- Consolidate support for NR-NTN above 10 GHz
- Support MBS
- Network based UE location
- UE without GNSS
- Support reduced NR bandwidth to 5 MHz or less
- Support of regenerative payloads
- Half Duplex FDD
- Coverage enhancement (Including UL/DL performance Enhancement such as Optimized CSI feedback to deal with CSI aging, Optimized DM-RS configuration)
- NTN/TN interoperability / coexistence

Low and medium throughput (LTE IoT based):

- UE without GNSS

- Network based UE location
- Support of regenerative payloads
- Coverage enhancement (Including UL/DL performance Enhancement such as Optimized CSI feedback to deal with CSI aging, Optimized DM-RS configuration)
- Half Duplex FDD
- Support MBS
- DL PAPR reduction

32 – Eutelsat S.A.

The R17 transparent payload is a limitation for further evolution in R18 and beyond. We support further study and work on regenerative payload for NR and IoT, particular interest in architectures that support ‘store-forward’ in the satellite to reduce the ground segment complexity for IoT (see IoT section).

We support a study support for devices without GNSS (both NR and IoT-NTN). The study could include support for devices in fixed locations, R17 capable devices with GNSS that experience temporary loss of GNSS or degraded GNSS location accuracy.

Multi-connectivity by using spatial diversity between NGSO & NGSO, GEO & NGSO and improve throughput and resilience (improved network availability) It should be the baseline assumption that operation with satellite nodes in the same orbits and different orbits are supported (e.g., LEO-LEO, LEO-GEO). Carrier aggregation could be beneficial but is considered a lower priority in R18 than establishing support for asynchronous multi-connectivity.

New bands should be considered on a release independent basis (not part of the R18 discussion).

33 – Deutsche Telekom AG

A clear gap analysis of what is NOT supported in Rel-17 AND relevant for initial business demands shall be the basis of any well scoped NTN evolution in Rel-18. We should not simply “port” anything which has been defined for TN to NTN.

Furthermore with Rel-18 we should clearly separate and define NTN and its differentiation from HAPS. Sat (both eMBB and IoT) should be treated as an independent WI to HAPS (while still any design/solution should make use/benefits out of potential commonalities).

Deutsche Telekom supports evolution of “HAPS” (see topic #15) and also “MBB/IoT via Sat” evolution in Rel-18 with well defined, market immediate market needs driven objectives.

34 – Rakuten Mobile

1. We propose to initiate RAN1 Study item “on improvement of link budget to provide Direct Access to smartphone”. 3GPP should ensure specification requirements to support NTN direct access to smart phone in Release-18

2. Current interference Co-ordination and mitigation schemes for LTE like eICIC and ABS are not suitable for “NTN to Terrestrial Network” we propose RAN1 Study Item to investigate co-channel Interference suppression and avoidance techniques for NR NTN to TN.

3. In Rel-17 only GNSS capable UE’s can access the NTN. We propose a possibility to support a user without GNSS capability in Rel-18.

4. Multi-connectivity -ENDC & MRDC should be supported in Rel-18.

2) Evolution of NR NTN (Non-Terrestrial Networks)

Feedback Form 2: Evolution of NR NTN (Non-Terrestrial Networks)

1 – Nokia France

Considering the motivations and degree of support in the workshop, our proposal for the top priorities is to focus on the following, in decreasing order of priority:

1. Enable operation without GNSS in order to increase availability of NTN services.

This was widely identified as important across multiple segments of the 3GPP ecosystem, and should therefore be considered very seriously. This could include:

- Specify methods for timing advance estimation for both initial access and connected mode without dependence on GNSS
- Specify method for Doppler estimation and/or pre-compensation without dependence on GNSS
- Specify modifications to mobility procedures to avoid dependence on GNSS
- Specify NTN-based positioning without dependence on GNSS

2. Specify improvements to NTN mobility and interworking in both active and idle/inactive modes (aiming to minimize energy usage, GNSS dependency and SIB reading, as well as ensuring good mobility performance). This could include:

- Optimizations for mobility/reselection for moving LEO satellites
- Sleep time / power-saving mode optimizations for sparse NTN deployments
- Study and specify improved mobility and interworking (potentially including multiconnectivity) between TN and NTN in order to provide seamless connectivity.

3. Specify techniques to reduce power consumption for NTN devices, especially in IDLE mode [RAN1/RAN2].

- Consider both RedCap devices and smartphones.

2 – THALES

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- *Throughput per UE, network throughput efficiency, signaling overhead*
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I.2 Candidate features for new capabilities enhancements:

- § NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE
- § Support of MBS
- § Network based UE location
- § UE without GNSS (Study phase only)

They may impact

- *regulatory compliance*
- *new bands*
- *new services*

II. RAN to consider the creation of a **Rel-18 work item eIoT-NTN** with the following candidate enhancements listed above (grouped according to the category of benefits)

II.1 Candidate features for performance enhancements:

- § Mobility enhancements
- § Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN

They may impact

- *network throughput efficiency, signaling overhead*
- *UE power saving, radio link failure, availability and reliability*

II.2 Candidate features for new capabilities enhancements:

- § Support for store-and-forward on-board NTN payload
- § IoT-NTN deployment in new bands (e.g. L band) (note that this activity can be carried out as part of a release independent work item) after March 2022

They may impact

- *Regulatory compliance*
- *New bands*
- *New services*

3 – THALES

RAN to consider the creation of a Rel-18 work item eNR-NTN with the following candidate enhancements:

§ Coverage enhancement :

- o Increase the service availability especially for commercial smartphones of Power Class 3 (featuring lower antenna gain e.g. -5 dBi) and possibly the target user throughput.

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

- o Satellite service allocated spectrum above 10 GHz currently addresses the totality of satcom mobile Broadband use cases and they address the largest portion of the existing satcom user base and market.
- o Currently VSAT/ESIM UEs are the pillar of satellite broadband services. Multiple VSAT/ESIM classes and apertures exist and a framework to support them shall be defined.

§ **DL PAPR reduction:**

- o High PAPR causes significant power efficiency loss and consequent throughput loss.
- o Issue has been identified both at FR1 and FR2, but due to typical payload architectures it is more significant in FR2 (above 10 GHz) - for transponder configurations of small number (<3-4) of OFDM channels per HPA, the throughput degradation may be severe. However PAPR alone is not a sufficient metric. OOB is also a significant player even in configurations with large number of carriers per-HPA, where carrier PAPR is less problematic.
- o It should be noted that high power fluctuation of CP-OFDM waveform affects all payloads in the forward link due to gain compensation/compression that may be necessary to normalize the PAPR to some extent even at lower frequency bands. Note that UL already enables DFT-s-OFDM.

§ **NTN-TN and NTN-NTN mobility and service continuity enhancements:**

- o Reduce the radio link failure rate for mobility across different access networks (NTN-TN and NTN-NTN). Important for scenarios that integrate NTN access and TN access in a single network (instead of NTN only operators).
- o This makes Satcom more relevant for existing TN operators (e.g. to extend coverage at sea or in sparsely populated areas). In addition, this enhancement would facilitate faster adoption of NTN in 5G.

§ **Support of NTN-NTN asynchronous multi connectivity & Carrier Aggregation**

- o Increase user throughput and QoE by using spatial diversity between NGSO & NGSO, GEO & NGSO.
- o Intra-satellite carrier aggregation is important in high frequency bands to provide very high throughput or increase the flexibility with frequency channel planning (smaller channels can improve link budget and can be aggregated if higher bandwidth is required).

§ **Support of MBS**

- o Meet for example public safety needs, software upgrades and multimedia content.
- o Favorable also for IoT (type of) applications that require e.g. triggering or distribution of messages.

§ **Network based UE location**

- o For regulated services (e.g. lawful intercept, emergency communications, public warning service) where Law enforcement apply, the network shall be able to provide a “reliable” UE location (either network verified or network provided).
- o In S3-210282 “Reply LS on UE location aspects in NTN”, SA3-LI 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.”

§ For emergency calls, in 3GPP TR 22.872 Study on positioning use cases; Stage 1 (Release 16), the position accuracy is required to be [50m Horizontal, 3m Vertical] which are the most demanding of the regulated

services in terms of accuracy requirements. (also in line with the European Commission 's Standardisation Request for E112 (as regards hand-held mobile phones in support of Directive 2014/53/EU)

§ For lawful intercept, SA3-LI recommends in S3i-200056 that “The logical location shall unambiguously map to the geographical area of the UE physical location. Granularity of such geographical areas needs to be able to provide network location accuracy comparable with terrestrial networks.”

§ **UE without GNSS (study phase only)**

- o Improve UE energy efficient and reduce dependency to GNSS service availability ; support of low cost UEs

4 – Qualcomm Incorporated

In our view, the evolution of NR NTN should build upon the foundation of Rel-17, adding new features and enhancements for the main use case (smartphone reception in remote areas). We would support focusing on the following areas of evolution:

- Coverage enhancements for smartphones: Although the techniques in Rel-17 CovEnh study item are applicable for NR NTN, there are no features defined especially for NTN. Given the challenging link budget (especially uplink) in NTN, RAN1 should focus on optimizing the performance at very low SNR levels. One area of focus is how adapting the use of multiple power amplifiers (full power MIMO) to the NTN case.
- Protocol simplification for voice: Supporting voice on NTN smartphones would be a necessary feature to compete with proprietary systems. Based on our observations, the performance of low-rate codecs in link budget limited situation is hindered by the large 3GPP protocol overhead introduced at the RAN (even when ROHC is enabled).
- Beam-based mobility: This was discussed at length during Rel-17, but down-prioritized due to lack of time. A complete solution to enable efficient mobility within the beams of a same satellite should be specified in Rel-18.
- NTN positioning: Enabling power efficient timing acquisition and more precise positioning estimates (NR NTN with LEO sat vs. GNSS with MEO).

5 – Apple Poland Sp. z.o.o.

a. Non GNSS operation : R17 NTN assumes UE has GNSS capability. However, UE may not always receive GNSS signals due to feature such as power savings, measurement gaps and infeasibility of signal itself. In this regards, enhancements related to UL synchronization in both RRC Idle and Connected modes become necessary.

b. Regenerative mode satellites : In R17 NTN focussed only on transparent mode. However, future NTN deployments seem to be pointing to regenerative satellites (in different configurations) which are highly desirable in terms of the reduced latency. Some enhancements related to time and frequency synchronization become necessary for R18 to support regenerative mode.

c. NTN-TN and vice-versa mobility: The treatment of mobility handling between TN and NTN has been minimal at best in R17. We wish to ensure that TN-NTN mobility can be treated further in terms of ensuring optimizations to the mobility procedures and potentially deal with CA, DC scenarios. Also regenerative mode will add in additional complexities and advantages both of which need consideration in terms of NTN-TN handovers.

d. **Beam management:** In R17, both single and multi-beams per cell configurations were covered. However, to avoid inter-beam interference and efficient frequency reuse, it is beneficial for satellite beams to use different BWPs across neighbors. In this regards, a beam specific BWP framework that facilitates association of beams to BWP, allows for joint UL/DL beam switching and beam measurements is needed. Potentially topics related to group-based beam switching mechanisms need to be studied as well, all of which we wish RAN can consider for R18.

6 – Guangdong OPPO Mobile Telecom.

On Rel-18 NR-NTN, our interested directions are:

- 1) associated BWP and beam to operate in an efficient way if not specified in Rel-17
- 2) enhanced beam measurement/management if not specified in Rel-17
- 3) enhancement to support smart devices
- 4) non-GNSS based terminals
- 5) support of regenerative satellites
- 6) CA/DC in NTN/TN

7 – China Mobile Group Device Co.

For R18 NTN, UE without GNSS or pre-compensation capability needs to be discussed, i.e. how to obtain UE location info. And mobility enhancements for intra-NTN and NTN-TN also need to consider firstly, especially NTN-TN mobility due to lack of discussion in R17. Further, spectrum sharing between NTN and TN is beneficial for improving spectrum utilization. Moreover, the applicability of all R17 enhancements under the regenerative architecture should be further study if time allow.

8 – China Mobile Group Device Co.

For R18 NTN, UE without GNSS or pre-compensation capability needs to be discussed, i.e. how to obtain UE location info. And mobility enhancements for intra-NTN and NTN-TN also need to consider firstly, especially NTN-TN mobility due to lack of discussion in R17. Further, spectrum sharing between NTN and TN is beneficial for improving spectrum utilization. Moreover, the applicability of all R17 enhancements under the regenerative architecture should be further study if time allow.

9 – CATT

We may need to sort out the enhancements with “high”, “middle” and “low” priorities, and we could focus on the “high” and or “middle” priority enhancements in Rel-18.

Potential enhancements with highest priorities:

1 □ Positioning enhancement

- UE without GNSS capability;
- GNSS not available for the GNSS capable UE;

Firstly, positioning with satellite is one value added service, and the integration between the communication and positioning using satellite is one obvious technical trend.

Secondly, for the UE without GNSS capability or GNSS not available case using cellular based NTN network for positioning is a nature choose.

Finally, current positioning feature in NR should be reviewed in NTN scenario, and potential enhancement is needed to guarantee the performance.

2 □ Support of Regenerative payload + ISL

By introducing Regenerative payload and ISL could increase the flexibility for network deployment; No big spec impact is foreseen to support regenerative payload, the design for transparent payload could be greatly reused; Support of ISL could be left to transport layer, no specification impact is expected.

3 □ Beam management enhancement

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.

Potential enhancements with Middle priorities:

1 □ DC operations

For DC operations, scenarios, benefits and the expected specification impact should be further clarified, e.g. whether support DC between two NTN cells, especially for earth moving cell deployment.

2 □ Coverage enhancement

For coverage enhancement, we understand it is needed to improve the user experience of satellite communication, especially due to impact of rain, cloud and other worse weather conditions

3 □ Mobility enhancement

Some companies suggested to further work on the mobility enhancement, but the target for mobility enhancement is not so clear now. Firstly, we need to identify the necessary enhancement for mobility, e.g. simplify the CHO procedure base on the knowledge of UE location info in the RAN node, consider DAPS like HO.

Potential enhancements with Low priorities:

1 □ support of MBS;

2 □ support of Redcap or small bandwidth;

The commercial requirement is not so clear for now. Due to the limit of time in Rel-18, this could be low prioritized.

10 – Spreadtrum Communications

We propose to consider following candidate enhancements in R18 NR NTN:

1. Rel-17 left overs

- Beam management enhancements

2. Coverage enhancement (for smart phone)

- Assessment of the gap from R17 coverage enhancements
- NTN-specific enhancements to uplink physical channels/signals

3. Enhancement on GNSS-equipped/Non-GNSS UEs cannot perform timing and frequency pre-compensation for uplink synchronization

- UL time/frequency sync enhancements
- Timing relationships enhancements

4. HD-FDD (e.g., Redcap)

- Timing relationships enhancements for HD-FDD

5. Regenerative Payload

6. Discontinuous coverage

11 – Beijing Xiaomi Mobile Software

The following enhancements are essential for Rel-18 NTN enhancement:

1) Data rate enhancement

In SA1 94e meeting, a new WI [S1- 211371] is approved on 5G system with satellite access to Support Control and/or Video Surveillance. The support of the video surveillance service may require higher data rate (several Mbps in the UL). It is needed to specify the enhancements to support higher data rate to meet the service requirement in Rel-18

- Specify the support the multiple connectivity for inter-satellite/intra-satellite operations.

2) Positioning enhancement

The time/frequency sync in Rel-17 design relies on the UE's location information via GNSS. However, the UE reported location information based on the GNSS may not be reliable as indicated in [R2-2102679]. Meanwhile, the GNSS signals may be blocked in some scenarios such as indoor

- Specify the network based positioning in NTN
- Identify the possible impacts for a UE without GNSS capabilities (either no GNSS receiver or GNSS not used for operating with satellite access).
- Specify the enhancements for UL time & frequency sync in idle and connected mode such as new PRACH design

3) Coverage enhancement

Support of smart phone is an essential aspect to enable commercial usage of satellite communication. The Tx/Rx antenna gain assumed for smart phone is around -5dbi which is 5 dB lower than the assumption for the handheld devices which may leads to coverage issue.

- Evaluate the coverage performance and identify the candidate channels that have coverage issues.
- Specify the necessary enhancements to fill the coverage gap.

4) Mobility enhancement

It is important to guarantee the service quality and reduce UE power consumption for UE mobility between TN and NTN. The Rel-17 mechanism for service continuity between TN and NTN will lead much handover interruption and UE power consumption.

- Specify the support enhanced schemes such as the DAPS to guarantee the service continuity.
- Specify the enhancements to handle mobility issues between the different access types/points/nodes.

Meanwhile, the following enhancements can also be considered:

5) New waveform design for DL PAPR reduction

6) New bands opportunities for NTN

7) MBS over NTN

12 – Ericsson LM

We should focus on enhancements which have a clear proven benefit. Among these, enhancements to mobility and energy efficiency should be prioritized. On the other hand, GNSS-less operation seems harder to justify, given that up to now GNSS is typically a pre-requisite for NTN UEs (to e.g. attach to the network etc.).

13 – DOCOMO Communications Lab.

We think at least the following can be included in the scope:

- Operation without GNSS
Better availability of NTN (including HAPS NW) can be achieved. For example, indoor UE, GNSS-incapable UE, UE in GNSS-unreliable UE (e.g. urban area with high-rise building).
- Dual connectivity between TN and NTN
When TN/NTN (including HAPS NW) cover same area, better robustness can be expected. For example, HAPS is prepared for NW under disaster, but both TN and NTN are available in normal time.

14 – Gatehouse Satcom A/S

The following NR-NTN candidate listing contains additional information / reasoning:

- Coverage enhancement

Increase service availability (for especially smartphones)

- DL PAPR reduction

Power efficiency and capacity (effective throughput) can be increased by reducing PAPR

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

NTN and TN should be seen as a complement to each other and benefit from being seamlessly supported by terminals., and especially in scenarios where terminals can connect to both TN or NTN within the same (operated) network.

- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Regenerative Payload

This will enable future (smaller) satellite constellations to deliver services that do not require lower latency and work especially in sparsely populated areas, and not necessarily need or can be connected to a ground station. It

very desirable to have support for regenerative payload and it is expected that the transparent specification can be reused to a very high extent to enable this.

- Support of MBS
- Network based UE location

This might be functionality that seems not important, though it is required to fulfil regulatory requirements (governmental, Law Enforcement, Emergency). Only UE provided location data is likely not accepted as reliable location data.

15 – NOVAMINT

In our view, the priorities of NR NTN Release 18 for a reasonable scope should be the following (in that order):

- Coverage enhancement (especially to address commercial smartphones)
- NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE
- DL PAPR reduction
- NTN-TN and NTN-NTN mobility and service continuity enhancements
- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Support of MBS
- Network based UE location

In addition, concerning UE without GNSS, we believe it is an important topic (for both NR and IoT) however it should be addressed as a feasibility study first.

16 – Lenovo (Beijing) Ltd

Our view on the possible objective for NR NTN is as following:

- Support smart phone in NTN, and consider compensating the link loss by linear antenna at UE side;
- Support coverage enhancement techniques to support smart phones in NTN
- Support UE without GNSS capability or availability. Enhancements may be needed on time/frequency synchronization, initial access, etc.
- Support regenerative-payload architecture. Enhancements on ISL and RAN3 interfaces may be necessary.
- Support CA/DC (intra-NTN and between NTN/TN). Enhancements on mobility and service continuity between NTN and TN may be necessary.
- Support network-based UE positioning. Study the corresponding RS design and measurement reporting, especially considering the channel characteristics in NTN.
- Support MBS in NTN. Study the SFN framework.
- Support Redcap in NTN. Reuse existing NR Redcap schemes and consider NTN-specific issues such as large propagation delay and high Doppler. Consider the typical case of Redcap, such as bandwidth, initial access, etc.

17 – Asia Pacific Telecom co. Ltd

From service level point of view, we suggest RAN Plenary to consider the following enhancements and their impacts to the Access Stratum Layer:

- Reliable & accurate UE location service over NTN, which would be beneficial for the UE to decrease its dependency of GNSS.
- NR Multicast & Broadcast Services.

From network point of view, service continuity over NTN/TN should be considered. Several sub-topics could be discussed, such as:

- NTN-TN mobility enhancements,
- NTN-NTN mobility enhancements,
- NTN coverage enhancements.
- Inter-working between TN-NTN & NTN alone should also be considered by RAN Plenary.

From resource point of view:

- specific spectrum opportunities (e.g., > 10GHz) for NTN should be considered.

18 – VODAFONE Group Plc

We would prefer to see some 3GPP-based satellite systems in operation before committing more resources to the standardisation of enhancements.

19 – Intel Corporation SAS

Enhancements for NR NTN FR1 deployments with smartphone UE should be considered (coverage enhancements).

Enhancements for scenarios with regenerative satellite payload can be considered (at least in RAN2/RAN3). Regenerative satellite payload was considered during Rel-16 NR NTN SI, however, this scenario is not supported in Rel-17.

In our view support of UEs without GNSS is not sufficiently well motivated to be included in the Rel-18 NTN. It is not clear what is the percentage of such UEs in the deployment. Also, support of UEs without GNSS will lead to degradation of system performance due to longer duration of PRACH reception window. Also, new PRACH design and closed-loop frequency control should be specified to support UEs without GNSS, it requires significant standardization efforts.

20 – Sony Corporation

We should discuss remaining items of release 17 (if any) at first. And then, we can consider the deprioritized items in rel.17. For example, UEs without GNSS capabilities, NTN Relays, and Re-regenerative payload could be possible items.

21 – ZTE Corporation

We are in general supportive to continue the enhancement on NR-NTN, but further tuning on the scope is preferred since in last WS, a lot of new features are proposed. In our views, following can be considered:

- UE with poor GNSS performance

In Rel-17, the pre-compensation based solution is specified by mandating the good GNSS performance at UE side. However, it's too restrictive and not realistic in commercial case. Enhancement on UL synchronization, e.g., RACH and closed-loop synchronization mechanism, should be prioritized.

- UL performance improvement

Further study on this aspect for smart phone is needed based on the solution defined in Rel-17 coverage enhancement. The basic functionality for VoNR-NTN should be supported as the baseline in this case.

- DL performance improvement

This aspect is to improve the performance for UE, e.g., VSAT or other types, to enable the large throughput in certain use case

- Beam management:

As remaining (potential) in Rel-17, optimization on this aspect should be addressed in R18 with higher priority, which is critical for LEO.

- TN-NTN mobility

This part can be done based on the leftover in R17.

- Re-generative payload

In our view, specify the required enhancement for full-gNB on board can be considered and justification on other layout, e.g., CU-DU split or IAB, should be further checked. The benefits for cost-reduction may not be significant as expected.

- NTN-NTN asynchronous multi connectivity & Carrier Aggregation

We are open for this direction, but prefer to only support the co-orbit case. Cross orbit solution, e.g., GEO+LEO, should not be considered.

- NTN-based positioning

We are open for this direction, but prefer to take the requirement identification firstly. Then, a long study phase to check whether corresponding enhancement is needed or not.

For others, e.g., MBS over NTN, PAPR reduction, inter-satellite link, it can be postponed in later release.

22 – MediaTek Inc.

With Rel-17 enabling minimum essential functionality for a working NR NTN system, Rel-18 need to:

- **Prioritize the service aspects** of NTN NR with **minimum additional enhancements** to Release-17 NTN NR functionalities as needed: enhancements for **VoNR** should be studied (due to e.g. UL link budget limitation) and **MBS** support defined.
- Enable **single device availability** to cover all NTN bands (half-duplex FDD)

We propose **NR NTN prioritizes** the following:

- **Regenerative architecture** to support very dense LEO satellite deployment (LEO satellites greatly outnumber GateWays on the ground, or no GateWay in the middle of oceans)
- **HD-FDD based on RedCap while avoiding BW/antenna restrictions**

- Support **Voice Over NR with packet interruption mitigation** due to low UL SNR and beam / cell switching for NTN
- Support **(Rel-17) Multicast Broadcast Service** for NTN

We propose the following NOT be included in Rel-18:

- Support of UE without GNSS would require new RACH and closed-loop frequency correction with numerous RACH transmissions in connected for high-velocity UEs, high impact on RACH capacity
- Network-based positioning (use GNSS)
- Beam management and BWP association (in scope of Rel-17)
- Coverage enhancement with higher slot aggregation / repetitions (up to 32 considered in Rel-17 NR Coverage Enhancements)
- DL PAPR reduction assuming NR waveform is implementation based technique, new waveform should be out of scope as would require new air interface
- Discontinuous coverage seems contradictory to mature LEO constellation, regenerative architecture
- RedCap channel BW reduction < 5 MHz would require new SSN design, proponent of this topic may consider using LTE eMTC

23 – InterDigital

At a high level, we think the eNTN WI should primarily focus on two aspects:

- **Broadening support for different UE device types** (i.e. support for non-GNSS UEs, direct connection to hand-held smartphone, support for RedCap UEs)
- **Enhanced integration between NTN and TN** (i.e. multi-connectivity between NTN and TN, and enhanced mobility/cell-(re)selection between NTN and TN)

24 – Samsung Electronics Co.

Regenerative payload with inter-satellite link

We think that regenerative payload and ISL are one set to be supported, where regenerative payload is a pre-requisite for ISL. The full advantage of regenerative payload cannot be utilized and the actual coverage of a satellite constellation is not extended compared to transparent payload. RAN WG3 will first discuss on which architecture will be used for regenerative payload among 1) gNB at sat (adaptation may be needed in NG), gNB-DU at sat (adaptation may be needed in F1), and 3) IAB-like sat (possible to support multi-hop routing, but large spec impact).

Multi-connectivity

We see multi-connectivity for NTN mainly for mobility enhancements. Similar to EN-DC, for example, the link with GEO could be the main anchor while the link with LEO could be the secondary. For spec impact perspective, the required features could be similar for multi-connectivity with GEO/LEO, LEO/LEO, and NTN/TN.

Operation without GNSS

Without GNSS capability at the UE side, Rel-17 NTN cannot be utilized because Rel-17 NTN is based on the assumption of GNSS positioning. But low cost terminals and for the case of weak GNSS signal may not be capable of GNSS positioning. In order to scale up the range of users that can access NTN, the

related enhancement is necessary. This might have large spec impact since new PRACH format, new TA mechanism, and new handling of Doppler shift are needed.

Leftovers that are not included in Rel-17

Depending on the progress of Rel-17 NTN, some enhancements which were studied during SI may not be supported in Rel-17 mainly due to lack of time. For example, support of large number of UEs (increase of RNTI values, signaling overhead reduction for large number of UEs HO, etc.), scheduling enhancements, some RRM and mobility enhancements (TN-NTN mobility enhancement for RRC connected UE, neighboring cells' measurement optimization, etc.).

25 – Classon Consulting

For FUTUREWEI

The proposed enhancement with the biggest potential benefit appears to be enabling ISL via regenerative payloads. We are less interested in “redoing Rel-17” for operation without GNSS.

26 – HUAWEI TECHNOLOGIES Co. Ltd.

Regenerative satellite

- Regenerative satellite can provide service coverage to areas where gateway cannot be deployed, e.g. deep-sea maritime areas
- The potential specification impacts include down-selecting network architecture options and potential optimizations of setup/release/resume (on e.g. NG interface) due to feeder link switch

UL coverage enhancement for smart phones

- It is beneficial to extend the UL coverage for smart phones in NTN to enable certain services
- There is a need to clarify the target deployment scenario such as the orbit, elevation angle, etc. and the performance target such as the service data rate
- Technologies specified in Rel-17 coverage enhancement should be taken into account when identifying the performance gap

UE without GNSS

- We see different proposals targeting different use cases and UE types (Smart phone, RedCap or IoT device), we suggest to further clarify the main use case and targeted UE types
- It seems a common understanding that a Rel-18 UE without GNSS cannot get access to a Rel-17 NTN network. The potential cost reduction and potential power consumption reduction due to no GNSS may not justify the limitation of not being able to access Rel-17 NTN network.
- In Rel-17 NTN, UE location is mandatory for UE to get access to the core network, i.e., the user location is needed for RAN to select the AMF CN. If UE GNSS information is not available, some other location mechanism(s) must be introduced before UE accessing the core network, which may require considerable standard effort (if at all feasible and able to meet the corresponding accuracy requirements)

Multi-connectivity: DC/CA between satellites and NTN/TN

- For both CA and DC, there is a need to identify the band/band combinations where input from satellite operators are appreciated
- Our understanding is that CA within one satellite is the most common and beneficial scenario.
- For DC, there is a need to further identify the scenarios since there is a large number of scenarios, e.g. transparent or regenerative, LEO&LEO, GEO&LEO, TN&NTN

- The motivation to support DC between NTN and TN is not clear since there is usually a large throughput difference between TN connection and NTN connection. As long as there is a connection to the TN, adding a connection to the NTN does not bring significant throughput benefit to the UE.
- When LEO is configured as an Secondary Node, there will be frequent addition/release of SNs, and the throughput/reliability benefit may not justify the increased signaling overhead

NTN Network based positioning

- Overall, the motivation to introduce NTN Network based positioning should be further clarified
- The main motivation expressed by some companies is to support trusted UE location for regulated services (e.g. emergency calls). It is important to understand the accuracy requirement of such services. According to our initial analysis, the accuracy of multiple-RTT-based method can be in the order of several hundred of meters. It is not clear whether such accuracy level can fulfil the regulatory requirement.
- It is also proposed by some companies that NTN based positioning makes it easier to support UEs without GNSS capability. We see a dilemma here since the UE would need position information to get access to CN but the UE would need to get access to the CN in order to perform RAT dependent positioning
- NTN-Network-based positioning requires comprehensive study efforts

27 – Fraunhofer IIS

High and medium throughput (NR based) to special types of terminals below and above 10 GHz:

- DL PAPR reduction
 - Satellite payloads are sensitive to PAPR of OFDMA signals
 - Feasible in Rel-18: DFT-s-OFDM in DL; benefit compared to OFDMA regarding total degradation
 - Waveform improvements potentially a topic beyond-5G / 6G
- Consolidate support for NR-NTN above 10 GHz
 - High throughput satellite systems are normally using frequency bands above 10 GHz, including bands above FR1 and below FR2 (Ku-Band) and those partly covered by FR2 (around 30 GHz for UL and around 20 GHz for DL). Interference between NGSO and GSO satellite systems is also a topic.
- Support MBS
 - Broadcasting is one of the main traditional use cases for satellites
- Network based UE location
 - Network based UE localization with 5G-NTN is essential to deploy telecom networks
- UE without GNSS
 - GNSS reception is not always possible and to support a flexible deployment of devices, connectivity w/o GNSS is required. In this case the Doppler and frequency compensation has to be performed by the UE w/o GNSS information
- Support reduced NR bandwidth to 5 MHz or less
 - In FR1, a flexible bandwidth with lower than 5 MHz are important to cope with the limited available spectrum allocated to satellite services.
- Support of regenerative payloads
 - To reduce the latency in the communication links, as well as to support ISL, regenerative payloads are required. However, especially for high throughput satellites, the on-board processing requirements are demanding

- Half Duplex FDD
 - o Half duplex reduces the overall RF requirements and costs of the user devices.
- Coverage enhancement (Including UL/DL performance Enhancement such as Optimized CSI feedback to deal with CSI aging, Optimized DM-RS configuration)
 - o With these enhancements, antennas with lower gain are supported, as well as deployment of devices under difficult propagation conditions or at the edge of coverage
- NTN/TN interoperability / coexistence
 - o Flexible spectrum access: More related to regulatory work, but access to satellite spectrum for IMT use and vice versa is crucial for global deployments.
 - o Enabling dynamic spectrum sharing (DSS) between TN and NTN: For a seamless connectivity, enabling of sharing between the bands is needed.

28 – Eutelsat S.A.

The power consumption, size and thermal impact of RF high power amplifier stages are extremely important aspects of many satellite payload designs. High amplifier efficiency whilst achieving the required RF performance (Power output, OOB, Vector-Error, etc.) depends heavily on the waveform characteristics. Techniques that can help improve transmitter chain efficiency (e.g. reduce the PAPR) are therefore a high priority to improving satellite payload efficiency.

We support Network based UE location (network verified/provided) work to the extent that it is required to achieve regulatory compliance.

29 – ESA

We support the following priority list:

- DL PAPR reduction
- Consolidate support for NR-NTN above 10 GHz
- Half Duplex FDD
- Support reduced NR bandwidth to 5 MHz or less
- Support MBS
- Network based UE location
- UE without GNSS

3) Evolution of IoT (Internet of Things) NTN

Feedback Form 3: Evolution of IoT (Internet of Things) NTN

1 – Nokia France

As the IoT NTN WI is only just beginning, it would be wise to focus any NTN work in Rel-18 on evolution of the NR NTN feature as in sub-section 2) above, and allow the Rel-17 IoT-NTN work to stabilise.

2 – THALES

RAN to consider the creation of a Rel-18 work item eIoT-NTN with the following candidate enhancements:

§ **Support for store-and-forward on-board NTN payload:**

- o An NGSO constellation typically requires several tens (MEO) or even hundreds (LEO) of satellites to provide service all over the Earth. Moreover, it requires that the constellation connects simultaneously a service area with a Core Network via a ground network infrastructure of gateways.
- o The support of store and forward capabilities will allow to start providing non real time IoT NTN services globally with only one satellite while reducing the required number of ground-stations which can be in deployed in 'friendly' locations.
- o The satellite need to embark eNB function and storage capability and will harvest data from IoT devices along its orbit and forward it to a core network when it encounters a NTN-GW. Conversely, it uploads data from core network when connected to a NTN-GW and delivers it to the relevant IoT-devices when covering the targeted service area. Store and forward allows IoT NTN service delivery in areas where the satellite is not, or cannot, be connected to a ground station when interacting with the UEs (i.e. "UE <-> satellite" signaling and data transfer shall be possible without the satellite being simultaneously connected to a central CN functionality on the ground).
- o This is important to have further cost effective and scalable solutions adopted by the market (in association with discontinuous coverage). Indeed, store and forward operation is already the native operation method used by other protocols (such as LoRa) competing for the low-cost satellite IoT market.

§ **Mobility enhancements:**

- o Optimize mobility signaling overhead and efficiency to avoid cell change when beam changes.

§ **IoT-NTN deployment in new bands (e.g. L band): (as part of a release independent WI)**

- o Allow to develop UE devices that can, operate with L band satellites and hence increase the market size of IoT-NTN.
- o The frequencies of L-band are interesting for IoT devices in general so could be a good complementary to S band.
- o L-band and XL-band are key frequencies already available to MSS for narrowband-type services, both real-time and non-real-time. Therefore, 3GPP should support them.

§ **Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN:**

- o Improve channel capacity and density of devices that can access to the satellite resources (alternative to NOMA).
- o Reduces UE power consumption and transmission latency by allowing the UE to transmit without undergoing full RACH procedure. May increase link budget, but this needs to be better understood.
- o Would also help with discontinuous coverage by shortening transmission time and increasing transmission capacity. However, there may be some improvements needed for PUR to support efficiently discontinuous coverage (transmission timing alignment).

3 – Qualcomm Incorporated

Due to the acceleration of the work in Rel-17, there are several features that are not supported. In our view, the focus during Rel-18 should be on the following:

- Operation without GNSS / with reduced GNSS usage: During the study it was recognized that GNSS measurements take a large percentage of the power in a typical IOT operation (short connections with small packets). On top of the power consumption benefits, reducing the dependency on GNSS would also allow to support longer connections, thus expanding the use cases for NTN IOT.

- HARQ disabling: This feature was recognized in the study item as providing power savings and increasing throughput, it should be specified in Rel-18.
- Enhancement for discontinuous / spotty coverage: Although this is in scope in Rel-17, it is unclear whether the solution would be complete due to the lack of work in SA/CT working groups such as potential changes to paging and PSM feature. Rel-18 work should provide a complete solution for both UE and core network to account for the case where the service link or feeder link connectivity are intermittent.

4 – Apple Poland Sp. z.o.o.

- a. Though the IoT NTN item has just started off in R17, one very important aspect that we feel needs to be considered is the support for discontinuous coverage. Due to the sparse initial deployments of satellite configuration in both space and time, extensions will be needed to the discontinuous coverage scenarios started in R17.
- b. Additionally we also think that NB-IoT should continue to follow on the enhancements of NR NTN from R18, for example, non-GNSS capabilities.
- c. UE Power savings will continue to be critical with the introduction of regenerative mode and hence might need another look for IoT NTN in R18.

5 – Apple Poland Sp. z.o.o.

- a. Though the IoT NTN item has just started off in R17, one very important aspect that we feel needs to be considered is the support for discontinuous coverage. Due to the sparse initial deployments of satellite configuration in both space and time, extensions will be needed to the discontinuous coverage scenarios started in R17.
- b. IoT NTN should continue to follow NR NTN for R18 also i.e. scenarios like non-GNSS operation. Additionally, power savings should continue to evolve with the introduction of regenerative mode of operation.

6 – China Mobile Group Device Co.

Because R17 IoT-NTN WI has just started, and the remaining time of R17 is also limited, R18 IoT-NTN should first solve the remaining issues of R17. Additionally, UE without GNSS and power saving enhancements should be focused on to the least extent. Similarly, discuss regenerative payload if time allow.

7 – Guangdong OPPO Mobile Telecom.

On Rel-18 IoT-NTN, our interested directions are:

- 1) eMTC over NTN for sporadic short transmission, if not specified in Rel-17
- 2) support for longer connection and power saving enhancements
- 3) support for high throughput
- 4) beam management to simplify network deployment
- 5) non-GNSS based terminals
- 6) support of regenerative satellites

8 – CATT

Share the view with Nokia.

For IoT NTN, we can focus on Rel-17 WI for now, no hurry to go for Rel-18. When we decide the scope of Rel-18 for IoT NTN, output from NR NTN could be taken as the reference.

9 – Spreadtrum Communications

We propose to consider following candidate enhancements in R18 IOT NTN:

1. Additional enhancements on the non-essential functionality in Rel-17

- HARQ
- Latency
- Power consumption
- Spectral efficiency
- High throughput
- Mobility

2. Multiple satellite beams in one IOT NTN cell (aiming to avoid frequent cell handover)

- Multi-carriers operation enhancements
- Beam management based on multi-carriers operation

10 – Beijing Xiaomi Mobile Software

The enhancements on IoT NTN should take the following aspects into account:

1) Support necessary enhancements in the sparse deployments

In the initial phase, the seamless coverage may not be provided by the NTN system. Necessary enhancements are expected.

- Solutions to support store-and-forward on-board NTN.
- Power efficient operations

2) UE without GNSS capability

- Solutions to support UL time & frequency sync in idle and connected mode

3) Mobility enhancement

- IoT-NTN handover enhancement on reducing handover signalling overhead and RACH congestion
- IoT-NTN and TN mobility enhancement

11 – Ericsson LM

We agree with Nokia, to focus on evolving NR NTN. As NB-IoT does not support connected state mobility, the benefits from the NTN regenerative architecture will not be as visible as for NR NTN (even though LTE-M does support connected mode mobility). But on the other hand, it seems beneficial to base both IoT NTN and NR NTN on the same architecture.

12 – Gatehouse Satcom A/S

The following IoT-NTN candidate listing contains additional information / reasoning:

- Support for store-and-forward on-board NTN payload

This will enable future (smaller) satellite constellations to deliver services that do not require lower latency and work especially in sparsely populated areas, and not necessarily need or can be connected to a ground station. It is very desirable to have support for regenerative payload and it is expected that the transparent specification can be reused to a very high extent to enable this.

- Mobility enhancements

Reduce the mobility signalling overhead.

- Preconfigured Uplink Resource

Improve the overall capacity of the satellite network, and especially a very desirable functionality for discontinuous coverage.

- Further enhancement to discontinuous coverage

Improve energy consumption on the UE side and allow for inter-cell mobility in the discontinuous coverage case.

- IoT-NTN deployment in L band.

13 – NOVAMINT

In our view, the priorities of eIoT NTN Release 18 for a reasonable scope should be the following (in that order):

- Support for store-and-forward on-board NTN payload in association with discontinuous coverage to have further cost effective and scalable solutions adopted by the market
- Mobility enhancements including Beam-based mobility / Multiple satellite beams in one cell
- Preconfigured Uplink Resource support and further power saving enhancements for IoT NTN in association with discontinuous coverage

In addition, we believe it is an important for IoT-NTN to support deployment in new bands (in particular L band). Though, this is RAN 4 driven and it should be independent of the releases (as per the discussion in June for Release 17). Therefore, we believe a Release independent work item should be created for the definition of new bands for IoT-NTN.

14 – Lenovo (Beijing) Ltd

Our view on the possible objective for IoT NTN is as following:

- Support UE without GNSS capability or availability. Enhancements may be needed on time/frequency synchronization, initial access, etc.
- Support regenerative-payload architecture. Enhancements on ISL and RAN3 interfaces may be necessary.

- Support discontinuous coverage due to sparse constellation. Further enhancements for UE power saving may be needed (could be depending on the conclusions of Rel-17 IoT NTN).

15 – Asia Pacific Telecom co. Ltd

- 1) Due to the power/hardware/software limitation of IoT device, we suggest a common solution should be discussed firstly and then we can discuss how to fit in these enhancements with IoT NTN.
- 2) To a IoT device, power saving gain should be the first criterion when we decide the priorities to introduce candidate enhancements into IoT NTN.

16 – NEC Corporation

Our expectation is that R18 should support features and deployment scenarios not covered in Rel-17, considering further improvement of power and spectral efficiency.

- **HARQ enhancement**

- Increasing the number of HARQ processes
- HARQ feedback disabling
- PDCCH monitoring reduction

- **Time and frequency synchronization enhancements**

- **Beam mobility**

- Support multiple beams in one IoT-NTN cell and avoid cell change when beam changes

- **Enhancements of supporting discontinuous coverage**

The enhancements in Rel-17 will not be enough to handle this case efficiently hence we propose:

- Mobility enhancement in RRC_Connected: Support CHO using satellite information for eMTC
- Support other IoT features in discontinuous coverage (e.g., preconfigured uplink resource)

- **Applicability of NR NTN evolution**

- SIB acquisition enhancement: Shared SI across multiple cells

17 – VODAFONE Group Plc

R17 is meant to cover the essential functionality, however, enhancement for discontinuous coverage could be valuable.

18 – Intel Corporation SAS

Leftovers from Rel-17 IoT NTN WI can be considered for Rel-18 after Rel-17 WI is completed.

Regarding support of UEs without GNSS, please see our comment on for evolution of NR NTN (Non-Terrestrial Networks).

19 – ZTE Corporation

For this topic, since only the ‘essential’ features are specified for Rel-17 with limited time, the remaining enhancement identified in SI phase should be prioritized firstly including followings:

- Enhancement on the supported UE density
For the massive IoT usage, the current capability should be further improved, especially for the RACH part.

- Enhancement on GNSS/SIB behavior for long transmission:

In Rel-17, the sporadic transmission is assumed to simplify the UE's behavior during the RRC connected state. However, it may not be realistic in commercial case since the duration is mainly up to the channel condition. We need to specify the additional mechanism for GNSS FIX/SIB acquisition for UE in RRC connected mode;

- HARQ related enhancement.

For others, we are negative to introduce the non-compatible assumption, e.g., UE without GNSS for IoT and beam management procedure (especially for NB-IoT). The regenerative related issue should also not be discussed for IoT-NTN since it's not match the assumption for low-cost satellite in IoT-NTN case.

20 – Sateliot

We support the following enhancements for eIoT NTN:

- Support for store-and-forward on-board NTN payload. This will enable service delivery in areas where the satellite is not, or cannot be connected, to a ground station. This is important to have further cost effective and scalable solutions adopted by the market (in association with discontinuous coverage). Indeed, store and forward operation is already the native operation method used by other protocols (such as LoRa) competing for the low-cost satellite IoT market.
- Mobility enhancements for multi-beam/multi-cell satellites. This will allow for more resource efficient beam layout configurations at the satellite level and optimize mobility signaling overhead and efficiency to avoid cell change when beam changes.
- Access optimization (e.g. Preconfigured Uplink Resource support) and further power saving enhancements for IoT NTN. Capabilities such as PUS may improve channel capacity and density of devices that can access to the satellite resources (alternative to NOMA). Moreover, UE power consumption and transmission latency may be also reduced by allowing the UE to transmit without undergoing full RACH procedure. May increase link budget, but this needs to be better understood. Would also help with discontinuous coverage by shortening transmission time and increasing transmission capacity. However, there may be some improvements needed for PUR to support efficiently discontinuous coverage (transmission timing alignment).
- IoT-NTN deployment in new bands. We support the creation of a Release independent WI for the definition of new bands for IoT-NTN. In addition to the consideration of current MSS allocations in L and S bands, consideration may be given as well to the potential new allocations for narrowband MSS to be decided in WRC'23 AI 1.18 as per Resolution 248. This represents new MSS spectrum that could be made available explicitly for intermittent, delay-tolerant IoT NTN services. Liaison between 3GPP and ITU WP4C may be considered to ensure the new MSS spectrum is made available under a proper arrangement suitable for 3GPP IoT NTN deployment.
- Further enhancement to discontinuous coverage operation, with a focus on further improving energy consumption on the UE side and improving network resource optimization (e.g. reachability awareness, paging resources).

21 – MediaTek Inc.

With Rel-17 enabling minimum essential functionality for a working IoT NTN system (NB-IoT and LTE-M), Rel-18 need to **prioritize** the following:

- **Disabling of HARQ feedback** to mitigate impact of HARQ stalling on UE data rates
- **Improved GNSS operations** for a new position fix for UE pre-compensation during long connection times

- Support of **(Rel-17) neighbour cell measurements** and corresponding measurement triggering before RLF for NTN.
- Support of **(Rel-17) NB-IoT carrier selection based on the coverage level**, and associated carrier specific configuration for NTN.
- Support **legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment mechanisms for NB-IoT NTN** to mitigate packet interruption for NTN to mitigate packet interruption for NTN

We propose the following NOT be included in Rel-18

- NOMA enhancement: In our understanding Rel-16 Contention-Based Preconfigured UL Resources (PUR) can be supported in very low UL SNR cases in NTN with proprietary implementation of NOMA in the eNB.
- DL capacity enhancements: cellular IoT releases specified numerous spectral efficiency enhancements benefiting both UL and DL – i.e. Rel-15 EDT, Rel-16 PUR, Rel-17 specified 16QAM on DL and UL, Rel-16 multi-TBS scheduling

22 – Samsung Electronics Co.

For NTN IoT, operation without GNSS should be considered in R18 for the purpose to reduce UE power consumption. As new mechanisms need to be introduced, the impact on UE complexity and power consumption should be assessed respect to the use of GNSS. Other R18 enhancements should prioritize coverage enhancements rather than throughput enhancements.

23 – InterDigital

We agree with Nokia and Intel. Any Rel-18 work should focus primarily on "leftover" aspects from Rel-17, as well as incorporating relevant enhancements from Rel-17 NR-NTN. We do see some use in supporting non-GNSS IoT UEs, however we hope this will primarily be addressed in NR eNTN, and solutions can simply be adopted (as was the case for many issues in Rel-17).

24 – Classon Consulting

For FUTUREWEI

It may be OK to focus on NTN rather than NTN-IoT in Rel-18.

25 – Sony Europe B.V.

Since the Rel-17 IoT-NTN work item focused on essential minimum functionality and short sporadic transmissions for both eMTC and NB-IoT, we think that the Rel-18 IoT-NTN work item should focus on functionality to support longer connections and target achieving the 5G KPIs in terms of capacity, latency, coverage and battery life.

The Rel-18 work should support both eMTC and NB-IoT for NTN.

Objectives should include:

Capacity

- Control / mitigate PRACH congestion after reading SIB for ephemeris information

Coverage

- Support for intermittent coverage / store and forward
- Improved UL coverage for eMTC devices operating in CE mode A

Battery life

- Reduction of PDCCH monitoring during round trip time
- HARQ enhancements to improve battery life, including the possibility of disabling HARQ feedback

Throughput

- Support longer RRC connections. The UE should be able to update synchronization (including reading ephemeris and GNSS measurements, if applicable, in RRC CONNECTED mode)
- Support higher data rate applications (it should be possible to use more of the UL and DL subframes than possible in Rel-17)

Latency

- HARQ enhancements, including study of disabling HARQ feedback

RF bands

- Support of more RF bands than in Rel-17, according to commercial requirements

26 – Fraunhofer IIS

Low and Medium Throughput (LTE IoT based):

- UE without GNSS
 - o UEs w/o GNSS enable lower cost of devices as well as deployments of devices where GNSS reception might be difficult.
- Network based UE location
 - o Network based UE localization with IoT-NTN is essential to deploy telecom networks
- Support of regenerative payloads
 - o To reduce the latency in the communication links, as well as to support ISL, regenerative payloads are required.
- Coverage enhancement (Including UL/DL performance Enhancement such as Optimized CSI feedback to deal with CSI aging, Optimized DM-RS configuration)
 - o With these enhancements, low cost antennas with lower gain are supported, as well as deployment of devices under difficult propagation conditions or at the edge of coverage.
- Half Duplex FDD
 - o Half duplex reduces the overall RF requirements and costs of the user devices.
- Support MBS
 - o Broadcast is not a traditional market for narrow band applications, but might be helpful e.g. for firmware updates
- DL PAPR reduction
 - o Since low data rate applications have lower order modulation, the PAPR reduction is of less priority, however still helpful for overall efficiency of the satellite system

27 – HUAWEI TECHNOLOGIES Co. Ltd.

HARQ enhancement

- We see the benefit to support features that can potentially enhance the UE throughput such HARQ disabling

Mobility enhancement

- The Rel-17 leftovers such as potential enhancement to cell selection/reselection, CHO and RLF/reestablishment for IoT-NTN can be considered

UE without GNSS or limit GNSS usage

- There is clearly some differences to support UEs without GNSS at all and UEs with limit GNSS usage from power consumption point of view, we suggest to further clarify the main use case
- Similar to NR NTN, It seems a common understanding that a Rel-18 UE without GNSS cannot get access to a Rel-17 NTN network. The potential cost reduction and potential power consumption reduction due to no GNSS may not justify the limitation of not being able to access Rel-17 NTN network.
- Similar to NR NTN, in Rel-17 NTN, UE location is mandatory for UE to get access to the core network, i.e., the user location is needed for RAN to select the AMF CN. If UE GNSS information is not available, some other location mechanism(s) must be introduced, which may require considerable standard effort (if at all feasible and able to meet the corresponding accuracy requirement)

28 – Eutelsat S.A.

Store-Forward: Support for store-and-forward on-board NTN payload. The primary benefit of Store-Forward is the reduction in ground segment – it reduces the number of ground-stations. Clearly introducing this capability will have a major specification impact (potentially more than RAN) and performance trade-off(s) to be considered (e.g., paging, disconnection timers, etc.) but the benefits are potentially very large.

Uplink improvements: Some companies have mentioned PUR. We note there has been some discussion in RAN1 for R17 already on this topic and acknowledge it is quite an interesting idea (if it can be made to work reliably, e.g., for GEO), however, this is at present unclear. We support a study which takes a broader view on uplink improvements; we would further suggest this work could be included in a study of non-transparent satellite architecture options (including store-forward and regenerative payload).

Note: Rel-17 for IoT NTN will be a minimal release and that Rel-18 will (also) have to include a number of leftover features (as yet unknown) that may be added to the above.

29 – ESA

We support the following priority list:

- Store-and-forward on-board NTN payload in association with discontinuous coverage
- Mobility enhancements including Beam-based mobility
- Preconfigured Uplink Resource support, including further power saving enhancements

4) Other comments for this topic [which do not fit into the two area bullets 2) & 3)]

Feedback Form 4: Other comments for this topic [which do not fit into the two area bullets 2) & 3)]

1 – Ericsson LM

We agree with Nokia, to focus on evolving NR NTN. As NB-IoT does not support connected state mobility, the benefits from the NTN regenerative architecture will not be as visible as for NR NTN (even though LTE-M does support connected mode mobility). But on the other hand, it seems beneficial to base both IoT NTN and NR NTN on the same architecture.

2 – Ericsson LM

Note to Moderator: please ignore and remove if possible, the above Ericsson LM comment to this feedback form, as it was meant for question 3). Apologies for this mistake.

3 – MediaTek Inc.

We propose to address **Spectrum re-use between NTN and TN** to enable MNOs, using their own spectrum assets, to reach into areas otherwise unreachable with traditional TN means. This **study** work ought to:

- **Define Scenarios of interest** incl. identification benefits of TN/NTN integration as enabled by 3GPP NTN to maximize spectrum utilization
- **Identify target spectrum and Regulation status**
- **Identify system impact**
- **Identify the corresponding NTN/TN co-existence effort**

1.2 Moderator Summary and recommendation for further discussion

1) General high-level views

The general consensus is to keep the Rel-18 scope limited and to focus on necessary enhancements and new functionalities based on deployment scenarios, optimizing performance, and use cases based on clear commercial needs.

A limited number of companies mentioned TN-NTN spectrum reuse as possible scope for Rel-18 with concern raised by others due to the regulatory aspects. Based on precedence on regulatory aspects, the moderator recommendation is to defer spectrum re-use discussions until there is a clearer regulatory view on this aspect.

Discussion on HAPS is covered in email discussion topic #15 and will not be further discussed in this thread.

2) Evolution of NR NTN (Non-Terrestrial Networks)

From views presented by companies, the moderator recommends further refinement on the high-level description for the following topics in the intermediate round. The list provided here is kept to a relatively large set of topics due to the NWM issues which may have prevented some views from being presented in the initial round.

- Coverage enhancement (to address commercial smartphones and VoNR)
- NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE

- NTN-TN and NTN-NTN mobility and service continuity enhancements
- NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation
- Support of MBS
- Network based UE location
- Power reduction for NTN devices
- Regenerative Payload with Inter-Satellite Link (ISL)
- Enhanced beam management
- Introduction of new bands in release-independent manner
- Study of DL PAPR reduction (new waveforms should not be considered in Rel-18)
- Study of UE without GNSS

3) Evolution of IoT (Internet of Things) NTN

From views presented by companies, the moderator recommends further refinement on the high-level description for the following topics in the intermediate round. The list provided here is kept to a relatively large set of topics due to the NWM issues which may have prevented some views from being presented in the initial round.

- Limited IoT-NTN scope in Rel-18 (focus primarily on remaining issues from Rel-17 and incorporating relevant enhancements from Rel-17 NR-NTN)
- Mobility enhancements
- Further enhancement to discontinuous coverage
- Support for store-and-forward on-board NTN payload
- Preconfigured Uplink Resource
- Power reduction for IoT NTN devices
- Introduction of new bands in release-independent manner

4) Other comments for this topic [which do not fit into the two area bullets 2) & 3)]

The only input here was concerning TN-NTN spectrum reuse. See moderator recommendation for item #1.

2 Intermediate Round

Companies are encouraged to provide their views and feedback on each item in order to be able to further refine the scope/objectives of each item, the commercial need in the Rel-18 timeframe, and their own company's views concerning each enhancement/feature. For each topic, please also provide your views on leading WG and secondary WGs (for the specific topic area) and identify any potential impact to SA/CT.

2.1 Collection of company views

2.1.1 Evolution of NR NTN (Non-Terrestrial Networks)

Feedback Form 5: Coverage enhancement (to address commercial smartphones and VoNR)

1 – Qualcomm Incorporated

In our view, this should be the main target of Rel-18. The clear advantage of 3GPP-based NTN vs competing technologies would be to have the possibility of communicating with your smartphone anywhere on Earth. The main target applications should be low-rate messaging and voice support. As indicated in our earlier reply, we should consider ways to improve the performance of low-rate codecs in link budget limited situation. NTN should coordinate with the coverage enhancement WID intended for the general NR to avoid duplicate work.

2 – ZTE Corporation

It's essential for the enabling the application of NTN. To identify this issue based on legacy design, we prefer to conclude the evaluation assumption firstly.

3 – Spreadtrum Communications

We agree that the scenario where the smartphone is connected via satellite needs to be supported in R18 NR NTN. Assessment of the gap from R17 coverage enhancements and NTN-specific enhancements to uplink physical channels/signals should be considered.

4 – Asia Pacific Telecom co. Ltd

- 1) We suggest to give NTN coverage enhancement (e.g., for smartphones and VoNR) a high priority.
- 2) Both the DL/UL enhancements on NTN should be considered jointly.

5 – Gatehouse Satcom A/S

We agree that this is an essential functionality that will support/enable smartphones to connect to a standardized communication technology from any position on earth.

6 – Lenovo (Beijing) Ltd

Coverage enhancement for smartphones is a clear and important topic to extend the commercial market of NTN. The coverage enhancement may enable NTN to provide affordable performance for most users in the market. Low-data rate services can be made available in a first step, and large data rate can also be considered by CA/DC between satellites. Therefore, we consider treating it as a higher priority. However, we also feel that we should first consider the applicability of the solutions presented in coverage enhancement WID to NTN and further identify the problems, if any.

7 – Beijing Xiaomi Mobile Software

Support of smart phone over NTN is importance to make a successful satellite communication system. This should be the high priority topic in Rel-18. We should identify the channels that have coverage issues based on the evaluation and specify necessary enhancements. This topic should be led by RAN1 and RAN2/RAN4 may be involved.

8 – Apple Benelux B.V.

Coverage enhancements are important and can be applied to the range of services.

9 – THALES

Justification (commercial needs)

Increase the service availability especially for the support of commercial smartphones of Power Class 3 (featuring lower antenna gain e.g. -5 dBi) which an important use case and possibly increase the target user throughput.

Objective

Evaluate the coverage performance and identify the candidate channels that have coverage issues. [RAN1, RAN2]

Define and specify repetitions and diversity techniques for the relevant channels (including PRACH) [RAN1, RAN2]

Define relevant CSI aging mitigation, DM-RS config. [RAN1, RAN2]

Involved WGs

Leading : RAN1

Secondary : RAN2

Potential impact to SA/CT

None

10 – CATT

We support to further work on coverage enhancement in Rel-18 to improve the user experience.

11 – vivo Mobile Communication Co.

We support to include coverage enhancement for smartphones in Rel-18 eNR-NTN objective. From the UE perspective, it would be beneficial for NTN commercialization, considering the limited transmit power for smartphone and long propagation through the atmosphere.

12 – Guangdong OPPO Mobile Telecom.

The coverage issue to support for commercial smartphones has been proposed by several companies. We think it can be treated in Rel-18 with high priority.

13 – DOCOMO Communications Lab.

If this topic is supported by many companies, we suggest to start this topic from study item to identify which aspect is insufficient for the motivated use case. This is same direction as Rel-17 TN coverage enhancement.

14 – KDDI Corporation

We agree with coverage enhancement of NTN, because low-rate messaging and voice support are basic and important service using NTN.

15 – MediaTek Inc.

The ability to use NR NTN with smartphones is essential, however we disagree that this would require NTN-specific work. If moving forward, Coverage enhancement with higher slot aggregation / repetitions should be downscoped.

On VoNR, as indicated, we need to investigate means to mitigate packet interruption due to low UL SNR and beam/cell switching for NTN.

16 – Rakuten Mobile

We support Study Item with objective of coverage enhancement to achieve Direct access to Smart Phone.

17 – InterDigital

Support as a primary objective. We see the primary use of NTN in 5G as an efficient and practical way to provide ubiquitous coverage, and coverage enhancements could enable basic 5G services (e.g. VoNR) globally for commercial smartphones. To save time work could adapt/enhance existing solutions from Rel-17 CovEnh WI as baseline, and effort should focus on LEO scenarios. Lead WG: RAN1; secondary WG: RAN2.

18 – Samsung Electronics Co.

First, we understand that Rel-17 NTN will be able to be also used for smartphone to connect NTN. For Rel-18, we can further consider the enhancements to support the commercial smartphone better.

19 – Intel Corporation SAS

In our view support of commercial smartphone UE is essential feature for NTN. Some study phase is needed before moving to normative work to identify required coverage enhancements, especially for RAN2 to understand the desirable protocol enhancements for VoNR in NTN.

20 – LG Electronics France

We think outcome of Rel-17 coverage enhancement can be applied for NTN. Thus, it should be firstly identified whether additional NTN-specific coverage enhancement is needed or not.

21 – Ericsson LM

We are OK to study this.

22 – Sony Corporation

Direct NTN connection from a smartphone is desirable. The data rates available will be limited, based on the link budget. Coverage enhancement techniques such as repetition will degrade data rates. We should therefore be targeting low data rate services, unless link budget assumptions are improved.

It is not clear whether or not there would be NTN-specific coverage enhancements. Can't NTN just use the coverage enhancements defined in the coverage enhancements WI?

23 – HUAWEI TECHNOLOGIES Co. Ltd.

- We see market potential to enhance the support of commercial smartphones in NTN. Coverage enhancement is one of the important areas for Rel-18 NTN evolution. However, similar to the other coverage enhancement WI (e.g. Rel-17 CE WI), the first step is to agree on deployment scenarios

and target service data rate so that the performance gap can be identified. We think the target service can be more generic rather than focusing on VoNR only. In addition, the solutions specified in Rel-17 CE WI should be taken into account as a baseline.

- For the support of VoNR in NTN, the feasibility of protocol simplification is questionable. Our initial analysis is that only the overhead of RLC head can be reduced which does not contribute too much for coverage extension.

24 – Fraunhofer IIS

Connecting commercial smartphones is one of the key aspects of NTN and will bring a real benefit, so any enhancement to achieve this goal by also enhancing the performance should be prioritized. Therefore, we agree to prioritize coverage enhancement.

Feedback Form 6: NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE

1 – Intelsat

We feel that NTN bands above 10 GHz are an essential requirement for the development of NTN. Also the definition of bands above 10 GHz for VSAT and ESIMs/ESOMPs is an imperative component for NTN.

2 – Qualcomm Incorporated

As agreed in previous RAN plenary, this work should start from RAN4, and RAN1 core specification impact should be kept at a minimum.

3 – ZTE Corporation

We are supportive on this feature, which is important to boost throughput for NTN in commercial usage. We prefer to focus on the enhancements, which are for throughput improvement. Regarding the frequency band, joint decision with consideration on RAN4's progress is also needed.

4 – Lenovo (Beijing) Ltd

We are generally fine with the intension to expand bandwidth for NTN.

5 – Beijing Xiaomi Mobile Software

The Ka band is one of the primary bands for the satellite communication. NTN deployment on above 10GHz band should be supported. This topic should be led by RAN4. Currently, we don't see a need to involve other RAN WGs at this stage.

6 – Spreadtrum Communications

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

7 – THALES

Justification (commercial needs)

Satellite service allocated spectrum above 10 GHz currently addresses most satcom mobile Broadband use cases and they address the largest portion of the existing satcom user base and market.

Currently VSAT/ESIM UEs are the pillar of satellite broadband services. Multiple VSAT/ESIM classes and apertures exist and a framework to support them should be defined

Such normative work should start as per RAN#92-e agreement in RP-211596.

Objective

Earth fixed & Earth moving cell reference scenarios are considered for GEO, MEO and LEO.

Specify the following requirements [RAN4]

- Study and identify which bands may be potentially relevant to NTN including: Analysis of regulations in the spectrum considered, Adjacent channel co-existence analysis
- Consider Ka band as exemplary
- Specify Rx/Tx requirements for different VSAT/ESIM UE class (not only 60 cm aperture)
- Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed.
- Specify the conformance testing
- Specify the RRM requirements

Involved WGs

Leading : RAN4

Secondary : RAN1

Potential impact to SA/CT

None

8 – CATT

We are ok with this objective.

9 – Guangdong OPPO Mobile Telecom.

Whether the spectrum above 10 GHz is available for NR-NTN deployment or not depends on RAN4 discussion.

10 – DOCOMO Communications Lab.

It seems that this item is dependent on RAN4 discussions as decided at the RAN plenary.

11 – Panasonic Corporation

We support this item to realize high throughput service by NTN.

12 – MediaTek Inc.

As summarized by Thales

13 – Rakuten Mobile

We agree with Thales summary of objectives.

14 – Samsung Electronics Co.

Protection of TN from the introduction of NTN should be ensured.

15 – Intel Corporation SAS

This topic should be considered in RAN4 according to agreements from the previous RAN plenary meeting.

16 – Ericsson LM

This heavily depends on the frequency range considered. We believe 3GPP should work within the band allocation done by the appropriate organizations.

17 – Fraunhofer IIS

For higher throughput use cases, higher data and higher bandwidth is required, which in satellite communications are supported in band above 10 GHz. So we agree to prioritize this item.

18 – HUAWEI TECHNOLOGIES Co. Ltd.

Our view is that the support of NTN deployment in above 10 GHz bands would require some work in RAN1 as well (in addition to RAN4 work which has been discussed in the previous RAN plenaries). In RAN1, some further study are required including the following aspects□

- Physical layer parameters such as SCS for SSB, data channels
- Beam management in FDD (the current beam management schemes in FR2 assumes TDD)
- Beam management in NTN considering the characteristic of satellite beams (e.g. large beam foot print size)

Feedback Form 7: NTN-TN and NTN-NTN mobility and service continuity enhancements**1 – Qualcomm Incorporated**

Existing mobility and service continuity methods from NR TN should be readily applicable for NR NTN. If minor adjustments are needed for existing methods to work, those should not be precluded, but we have not seen any need to introduce entirely new mobility or service continuity enhancements specifically for NTN.

2 – Spreadtrum Communications

We agree that NTN-TN and NTN-NTN mobility and service continuity enhancements can be considered in R18. Existing methods from NR TN can be considered as baseline.

3 – ZTE Corporation

There is on-going discussion in Rel-17 for this aspect. If eventually, no solid progress has been made, we can further treat it as leftover with specific candidate solution or scope.

4 – Lenovo (Beijing) Ltd

Intra-NTN mobility has been discussed in Rel-17 WI and enhancement to CHO with NTN-specific triggering conditions (time/location) has been decided. Further mobility enhancements for intra-NTN can be

considered if new issues are identified in Rel-18.

Enhancement to TN-NTN mobility and service continuity are currently with lower priority in Rel-17 WI. This topic is however important for the commercial performance of NTN and should be studied in Rel-18. Intra-NTN mobility enhancement in Rel-17 can be considered as baseline.

5 – Beijing Xiaomi Mobile Software

We support to work on the TN-NTN and NTN-NTN mobility in Rel-18 and this topic should be led by RAN2.

In Rel-17, we don't have enough time to discuss the TN-NTN mobility fruitfully, so this part can be done based on the R17 leftover. For NTN-NTN mobility, we think the issues of handover interruption, handover signalling overhead and RACH congestion should be resolved.

6 – China Mobile Group Device Co.

Mobility enhancements for NTN-NTN and NTN-TN also need to consider firstly, especially NTN-TN mobility due to lack of discussion in R17

7 – Apple Benelux B.V.

We feel this item should be at a higher priority compared to the NTN-NTN multi-connectivity and CA scenarios.

8 – THALES

Justification (commercial needs)

Reduce the radio link failure rate during mobility across different access networks (NTN-TN and NTN-NTN).

Important for scenarios that integrate NTN access and TN access in a single network (instead of NTN only operators). This makes Satcom more relevant for existing TN operators (e.g. to extend coverage at sea or in sparsely populated areas). In addition, this enhancement would facilitate faster adoption of NTN in 5G.

Objective

Support enhanced schemes such as the DAPS to guarantee the service continuity.

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

Involved WGs

Leading : RAN2

Secondary : RAN1

Potential impact to SA/CT

Possibly Mobility and session management

9 – CATT

For TN-NTN service continuity, it is under discussion in NR NTN Rel-17, the leftovers or necessary enhancement could be continued in Rel-18.

For intra NTN mobility, we're not sure what kind of enhancement is needed.

One thing to be mentioned here:

As the follow-up actions to Rel-17, do we need to consider the feeder link switch in case of de-centralized configuration? I.e., the information exchange between the gNBs may need to be further investigated.

10 – vivo Mobile Communication Co.

We support to include both NTN-TN and NTN-NTN mobility in Rel-18 eNR-NTN objective, and prioritize DAPS enhancement.

11 – Guangdong OPPO Mobile Telecom.

This is still being discussed in Rel-17. Depending on Rel-17's progress, those leftover issues (if any) can be further discussed in Rel-18.

12 – DOCOMO Communications Lab.

We do not see clear necessity of this topic. Even if necessary, it should be RAN2 work. RAN1 work is unclear for us.

13 – MediaTek Inc.

We share the view expressed by Qualcomm

14 – Samsung Electronics Co.

We think some leftovers from Rel-17 need to be continued in Rel-18. NTN-TN mobility should be the one which was deprioritized in Rel-17. For NTN-NTN mobility, it would be better to clarify more what exactly needs to be enhanced, e.g. is it related to leftovers from Rel-17 or new enhancements? And we think the corresponding measurement aspects should be also enhanced, such as “NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements”

15 – InterDigital

Support as a primary objective. Seamless continuity between TN-NTN is important from a user-experience perspective especially if commercial smartphones can support NTN in Rel-18. Furthermore, considering the vast differences in terms of delay and link quality between TN/LEO/GEO there may be a need to enhance prioritization of one network type over another e.g. considering service type or power requirements. Lead WG: RAN2; Secondary WG: RAN1/RAN3/RAN4

16 – Samsung Electronics Co.

Enhancements to support a large number of UEs need to be considered in NTN, e.g. signaling overhead reduction for large number of UEs HO, increase of RNTI values, etc. Some was already studied during SI phase, but we assume it may not be prioritized in Rel-17 due to lack of time.

17 – Intel Corporation SAS

We think that it would be better to wait until Rel-17 NR NTN WI completion to identify leftovers on this topic.

18 – Ericsson LM

We are OK to study this. In Rel-17 no compelling feature for TN-NTN mobility was found, but we need to revisit this in light of the regenerative architecture.

19 – Sony Corporation

NTN-TN service continuity is important and should consider: (1) preferred network when there is both NTN and TN coverage (2) power consumption on TN measurements for a UE that is currently in NTN only coverage.

20 – Fraunhofer IIS

Mobility between TN and NTN in terms of service continuity enhance the user experience, but could be also addressed in later releases after the connectivity in general has been improved.

21 – HUAWEI TECHNOLOGIES Co. Ltd.

We think mobility and service community enhancement can be of second priority given the current mechanism can already support the basic cell-(re)selection/handover between NTN-TN and NTN-NTN.

Feedback Form 8: NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation

1 – Qualcomm Incorporated

While we think this may be useful when satellite constellations get dense enough, we think it is too early to focus on this (initial deployments of NTN may cater for coverage more than for capacity).

2 – ZTE Corporation

We are open to this topic. Before the study, we prefer to identify the prioritized scenarios firstly, otherwise, the assumption will be dramatically different, e.g., level of asynchronous.

3 – Asia Pacific Telecom co. Ltd

- 1) This feature may be nice to have.
- 2) If RP decides to address this topic, we suggest cover the frequency carriers >10 GHz.

4 – Lenovo (Beijing) Ltd

Multi-Connectivity & Carrier Aggregation can be useful for optimizing performance of NTN. Mobility performance, service continuity and throughput can be improved and enhancement for NTN application may be necessary.

5 – Beijing Xiaomi Mobile Software

Support multi-connections is an efficient way to boost UE's throughput as well as to improve the mobility performance. The multi-connection can be done within a satellite or between satellites. CA-like operation can be applied if the transmission delay between the node(s) is constrained within a certain threshold. Otherwise, DC-like operation can be applied. This topic should be led by RAN1 or RAN2, RAN4 should also get involved.

6 – Apple Benelux B.V.

Compared to NTN-TN mobility, this should be a lower priority item from our view.

7 – Spreadtrum Communications

We are fine to discuss multi-connectivity & carrier aggregation in R18 NR NTN. Reasonable and beneficial scenarios need to be identified firstly.

8 – THALES

Justification (commercial needs)

Increase user throughput, QoE and/or service availability by using spatial diversity between NGSO & NGSO, GEO & NGSO. Note that NGSO encompass LEO and MEO.

Intra-satellite carrier aggregation is important in high frequency bands to provide very high throughput or increase the flexibility with frequency channel planning (smaller channels can improve link budget and can be aggregated if higher bandwidth is required).

Objective

It is assumed that satellite nodes may be at different orbit (e.g. LEO, MEO and GEO).

Address different delay and/or network topology between the different access types/points/satellite nodes. [RAN1, RAN2]

Handling different time and frequency compensation. [RAN1, RAN2]

Master node versus secondary node selection. [RAN2, RAN3]

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

In option support of NTN-TN asynchronous multi connectivity

Involved WGs

Leading : RAN1

Secondary : RAN2, RAN3, RAN4

Potential impact to SA/CT

Possibly split bearer at core network (e.g. UPF)

9 – CATT

We do not see there's any urgent requirement to support NTN-NTN CA/DC.

Requirements should be clarified, e.g. what's the benefit to support CA/DC between two LEO cells.

To our understanding, LEO-GEO coordination is something interesting, however, this also have specific requirement to the UE capability.

10 – vivo Mobile Communication Co.

For NTN-NTN asynchronous multi-Connectivity, we would like to include NTN-TN DC in this objective additionally, in which case NTN can provide coverage and TN can assist to increase throughput. For NTN CA, we prefer to study synchronous intra-band CA case with high priority.

11 – Guangdong OPPO Mobile Telecom.

In general, CA/DC can bring obvious data rate enhancements for UEs and should be considered in Rel-18 NTN. Regarding CA/DC scenarios, we are not sure for now we should only focus on the asynchronous case. Instead, both synchronous and asynchronous CA/DC (when applicable) should be in the scope.

12 – DOCOMO Communications Lab.

This topic would be a potential enhancement, but we do not see urgency. This topic can be deprioritized.

13 – KDDI Corporation

This enhancement is beneficial to increase capacity for eMBB. On the other hand, we think that an initial deployments of NTN will provide for area coverage more than for capacity.

14 – MediaTek Inc.

We do not see a strong motivation nor urgency for this topic

15 – Rakuten Mobile

We support the proposal from Thales. The key interest for us is to ensure reliability for critical services through Dual Connectivity.

16 – Samsung Electronics Co.

As we explained, we see multi-connectivity for NTN mainly for mobility enhancements. Similar to EN-DC, for example, the link with GEO could be the main anchor while the link with LEO could be the secondary. For spec impact perspective, the required features could be similar for multi-connectivity with GEO/LEO, LEO/LEO, and NTN/TN.

17 – InterDigital

Support as secondary objective/Down-prioritized. We see some use to have different constellations provide services based on their delay/orbital characteristics e.g. quasi-fixed nature of GEO satellites is useful for paging and delay characteristics of LEO for data transfer/VoNR. However, we already have constellation-specific enhancements to partially address these aspects (e.g. disabling HARQ in GEO to improve latency, tracking area enhancements for LEO), so this is not a critical enhancement. Lead WG: RAN2; Secondary WG: RAN1/RAN3

18 – Eutelsat S.A.

Multi-connectivity could bring benefits in terms of system availability and throughput. LEO-LEO (NGSO-NGSO) and LEO-GEO (NGSO-GEO) scenarios are of interest. For example, scenarios where GEO coverage is available and NGSO is sometimes/ usually available are potentially relevant even in early deployments.

19 – Ericsson LM

In principle we are OK to look at this area, but we need to keep in mind that in some cases there may be overlaps with parallel work for terrestrial NR (e.g. Multi-Connectivity, which is a general Rel-18 proposal for NR). So, we should not do MC for NTN without a stable foundation for TN.

20 – Sony Corporation

We think that supporting service continuity between TN and NTN is more important rather than addressing increased throughput in Rel-18. However, if there is support to address increased throughput then we prefer starting with CA first.

21 – Fraunhofer IIS

This feature might be shifted to later releases, after solving essential functionality and performance enhancements.

22 – HUAWEI TECHNOLOGIES Co. Ltd.

- Instead of have a generic statement to support CA and DC for NTN, a fine-tuned selection of scenarios would be beneficial to understand the scope. One may also need to focus on UE throughput improvement in this objective since mobility enhancement is listed separately.
- From spectrum point of view, there is a need to identify the band/band combinations for both CA and DC. This may further defined depending on operator's need.
- Regarding deployment scenarios□
 - o We think CA within one satellite is the most common and beneficial scenario
 - o For DC, there is a need to further identify the scenarios since there is a large number of scenarios, e.g. transparent or regenerative, LEO&LEO, GEO&LEO, TN&NTN
 - o The motivation to support DC between NTN and TN is not clear since there is likely a large throughput difference between TN and NTN connection. As long as there is a connection to the TN, adding a connection to the NTN does not bring significant throughput benefit to the UE.
- Other aspects to consider
 - o When LEO is configured as an Secondary Node, there will be frequent addition/release of SNs, the throughput/reliability benefit may not justify the increased signaling overhead

Feedback Form 9: Support of MBS

1 – Verizon UK Ltd

We didn't get a chance to speak up during the first round. This is like our first round comment - we support having MBS on NTN - we think there are valuable use cases there.

2 – Qualcomm Incorporated

It is unclear to us what is missing in Rel-17 specifications (NR MBS + NR NTN) to enable this. So, we do not see a need to have this as an explicit objective.

3 – ZTE Corporation

The MBS over NTN can be done later once the critical issue has been identified.

4 – Asia Pacific Telecom co. Ltd

- 1) MBS may become a critical implementation in NTN.
- 2) However, from service's point of view, we have not discuss whether the NTN could support the QoS requirements of one NR MBS session (e.g., based on the PTP/PTM legs configuration, HARQ protocols,

and mobility enhancements which are supported for NR MBS).

It may be necessary to further investigate possible issues when we decide to implement NR MBS on NR NTN.

5 – Lenovo (Beijing) Ltd

MBS matches the characteristics of large coverage in NTN, providing the possibility of serving 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 large propagation delay or satellite movement.

6 – Beijing Xiaomi Mobile Software

Support of MBS service is valuable use case due to the nature of satellite coverage. This topic should be led by RAN2 if time allows.

7 – Apple Benelux B.V.

We are ok to consider support for MBS based on the scope of the item which is unclear at this point.

8 – THALES

Justification (commercial needs)

Meet for example public safety needs, software upgrades and multimedia content.

Favourable also for IoT (type of) applications that require e.g. triggering or distribution of messages.

Objective

Multicast accommodating extra delay (including HARQ deactivation). [RAN2]

Address Broadcasting Service continuity issues in NGSO when targeting a specific geographical area. [RAN2]

Support Mobile-Originated and Network-Originated multicast and related mobility aspects in NGSO taking into account beam topology. [RAN2]

Involved WGs

Leading : RAN2

Secondary : RAN1, RAN3

Potential impact to SA/CT

Possibly Mobility & session management (SA2), security (SA3)

9 – CATT

Specification impact should be identified to adopt MBS in NR NTN.

We support MBS in NR NTN in Rel-18 only if MBS could be supported without any RAN impact or only very limited specification impact.

10 – Guangdong OPPO Mobile Telecom.

MBS is a promising technique to provide services for public safety, video and radio transmissions under NTN deployment. We think MBS can be included for NR-NTN in Rel-18.

<p>11 – DOCOMO Communications Lab.</p> <p>We have same view with QC and others. Why Rel-17 NTN + Rel-17 MBS are insufficient is unclear for us.</p>
<p>12 – MediaTek Inc.</p> <p>Need to ensure MBS is possible over NR NTN - a short gap analysis may be necessary</p>
<p>13 – Rakuten Mobile</p> <p>Like other's we do not understand the need for this Work Item.</p>
<p>14 – Samsung Electronics Co.</p> <p>We think Rel-17 MBS can be used also for NTN.</p>
<p>15 – InterDigital</p> <p>Down-prioritized. We think other solutions are more important in this release but would be open to consider in a Rel-19+ timeframe.</p>
<p>16 – Intel Corporation SAS</p> <p>In our view there is no urgency to specify MBS NTN, it can be considered in future releases after Rel-18.</p>
<p>17 – LG Electronics France</p> <p>We think MBS is not really needed in NTN, because broadcasting will not be effective in the large NTN cell coverage area.</p>
<p>18 – Eutelsat S.A.</p> <p>Not a priority in R18 timeframe.</p>
<p>19 – Ericsson LM</p> <p>In principle we are OK to study this, but it should not have a high priority.</p>
<p>20 – Sony Corporation</p> <p>We think both multicast and broadcast services should be supported. A multicast service may preferably be supported over TN and then handed over to NTN due to e.g. coverage reasons.</p>
<p>21 – Fraunhofer IIS</p> <p>Thales summarized well the justification, objectives and impact of MBS, which we consider as an important use case for NTN.</p>
<p>22 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We don't see an urgency market need to support NTN MBS.</p>

Feedback Form 10: Network based UE location

1 – Intelsat

Network based UE location is an important enabler for both NTN and NTN-IoT. Further it supports UE without GNSS if that becomes a requirement.

2 – Qualcomm Incorporated

We would support having some study to determine how the network can determine the UE location without relying on UE GNSS measurements. On top of “network-based” UE location, LEO satellites may be used by the UE to achieve higher accuracy (by “UE-based positioning”).

3 – ZTE Corporation

We are open to this direction, but prefer to clarify the scope and corresponding requirement. For example, if the intention is to define the purely LEO/GEO based solution to enable the “network-based” UE location, high workload is expected.

4 – Asia Pacific Telecom co. Ltd

We support RP to discuss how the UE eliminate/decrease its dependency to GNSS and it would be beneficial to both UE & IoT UE.

5 – Gatehouse Satcom A/S

Network based UE location is important. Both from a regulatory (requirement) perspective, as well as from the possibilities that it could be used for increasing accuracy or validation of the UE position data that might be available.

6 – Lenovo (Beijing) Ltd

Further enhancement to network-based UE location considering NTN channel characteristics may be necessary. The corresponding RS design and measurement reporting can be studied. We prefer to treat this with higher priority as it may become a prerequisite for UE without GNSS.

7 – Beijing Xiaomi Mobile Software

We do see a need to support network based UE location due to the reliability/trusty issues identified. The network based positioning for NTN may differ in many aspects compared to the one in TN system. We need to firstly identify the requirements for network based positioning and specify the necessary solutions. This topic should be led by RAN1, RAN2/RAN4 should also get involved.

8 – China Mobile Group Device Co.

This is helpful for both NTN and IoT-NTN to obtain UE location info. And if we want to implement UE pre-compensation, location information is very important. Besides, other solutions for UE location acquisition could also not be excluded.

9 – Apple Benelux B.V.

Existing mechanisms are sufficient and we dont need any additional optimization here considering the discussions from R17 did not lead to a clear majority. If we are to do something on this we prefer this item be taken to Positioning Enhancements of R18 rather than in NTN.

10 – THALES

Justification (commercial needs)

For regulated services (e.g. lawful intercept, emergency communications, public warning service) as well as handling of extraterritoriality requirements where Law enforcement apply, the network shall be able to provide a “reliable” UE location (either network verified or network provided). The first priority is to enable the network to verify UE reported location information.

In S3-210282 “Reply LS on UE location aspects in NTN”, SA3-LI 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.”

- For emergency calls, in 3GPP TR 22.872 Study on positioning use cases; Stage 1 (Release 16), the position accuracy is required to be [50m Horizontal, 3m Vertical] which are the most demanding of the regulated services in terms of accuracy requirements. (also in line with the European Commission ‘s Standardisation Request for E112 (as regards hand-held mobile phones in support of Directive 2014/53/EU)
- For lawful intercept, SA3-LI recommends in S3i-200056 that “The logical location shall unambiguously map to the geographical area of the UE physical location. Granularity of such geographical areas needs to be able to provide network location accuracy comparable with terrestrial networks.”

Objective

Enhance existing RAT dependent techniques (e.g. multi RTT) to accommodate varying and larger delay. [RAN1]

Signalling overhead and efficiency impact. [RAN2]

Enhance UE positioning architecture e.g. LMF [RAN2 & 3]

Involved WGs

Leading : RAN1

Secondary : RAN2, RAN3

Potential impact to SA/CT

Triggering conditions. LCS framework. Compliance with regulated service requirements (network provided or verified) as well as extraterritoriality requirements (See SA1 led 5GET study)

11 – CATT

As specified in the 1st round comment, it’s valuable to adopt Network based UE location mechanisms.

Just thinking how to proceed the work, should this be done in NR NTN WI or in Positioning WI or a separate WI?

12 – Guangdong OPPO Mobile Telecom.

If this means NW-based positioning, we are not sure if this should be handled in the positioning enhancement area.

13 – DOCOMO Communications Lab.

Same comment as OPPO. If this topic means positioning, it should be handled in ”positioning” discussions, not in NTN discussions. There is a same situation - SL positioning.

<p>14 – Panasonic Corporation</p> <p>We support this item in conjunction with “UE without GNSS”.</p>
<p>15 – MediaTek Inc.</p> <p>We see no motivation for this. UE GNSS capability as in Rel-17 remains a basic assumption.</p>
<p>16 – Rakuten Mobile</p> <p>Like Panasonic, we support this Study item as part of ”UE without GNSS”</p>
<p>17 – InterDigital</p> <p>Support as primary objective. This would not only enable non-GNSS UEs to access NTN but could support existing terrestrial positioning methods as well. Our concern is that this may end up taking a lot of time, so scope should be very carefully considered and leverage existing positioning solutions as much as possible. Lead WG: RAN2 Secondary WG: RAN1/RAN3</p>
<p>18 – LG Electronics France</p> <p>We can consider leftover issues in R17 NTN.</p>
<p>19 – Eutelsat S.A.</p> <p>Network based UE / Device location is desirable to reduce dependence on GNSS. It is important in some applications and may be an essential regulatory requirement (e.g. validate the credibility/ accuracy of other position data).</p>
<p>20 – Ericsson LM</p> <p>As commented by satellite companies on a few occasions in WG meetings, today’s NTN UEs typically do GNSS to ensure a prompt network attach (estimating the most likely satellite(s) according to date, time and position), so it seems like an accepted implementation. We do understand the desire to reduce UE complexity, but we should consider that also terrestrial UEs, are subject to the same trend (and by the way they typically include GNSS). The “natural” benefit of GNSS for NTN is that it does not require to introduce NTN-specific network-based positioning methods (today’s specified methods assume TN geometry, and this makes them inapplicable to NTN). A proper evaluation of network-based location for NTN will need to involve positioning experts in 3GPP and will require a dedicated SI.</p>
<p>21 – Sony Corporation</p> <p>For Rel-18, GNSS-based location is still fine and so all NTN UEs should have GNSS capability.</p>
<p>22 – Fraunhofer IIS</p> <p>Thales summarized well the justification, objectives and impact for Network based UE location. We highly recommend to prioritize network based UE location as this is mandatory required for e.g. regulatory issues and public safety.</p>
<p>23 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We don’t support NTN network based positioning in Rel-18. We see different views regarding the motivation to introduce this feature.</p>

- Some companies think the main motivation is to support trusted UE location for regulated services (e.g. emergency calls) and it is important to understand the accuracy requirement of such services. According to our initial analysis, the accuracy based multiple RTT based method can be in the order of several hundred meters. It is not clear whether this can fulfil the requirement.
- Some other companies think NTN based positioning can support UEs without GNSS capability. We see a dilemma here since the UE would need position to get access to CN but the UE would need to get access to the CN in order to perform RAT dependent positioning

We would like to note that NTN Network based positioning would require comprehensive study efforts in RAN1 where it seems that positioning-related topics are already crowded.

Feedback Form 11: Power reduction for NTN devices

1 – Qualcomm Incorporated

In our view, power consumption reduction is not the primary objective of the work but if existing NR features can be reused (for free), that is nice to have. But this does not need to be explicitly a Rel-18 NR NTN WID objective.

2 – ZTE Corporation

The needs for power reduction is not clear. If the intention is to optimize the power cost due to the usage of GNSS, maybe we take it later since it's more critical for IoT device. Regarding other purpose, due to the poor UL budget, there is limited room to optimize the power consumption for handheld (e.g., smart phone). For VSAT-alike UE, the power may not be the main concern.

3 – Lenovo (Beijing) Ltd

Power saving for NTN may be treated with a lower priority. Optimization in ephemeris provisioning may be studied to reduce broadcasting overhead.

4 – Beijing Xiaomi Mobile Software

The only scenario we see for power reduction may be the sparse deployment case, however, this may not be an essential topic for NTN devices in Rel-18.

5 – Apple Benelux B.V.

We can consider this item, if it can be limited to RAN2 scope based on the observations made in the SI. A better way to achieve this from our view would be to identify latency reduction enhancements and apply existing power saving mechanisms on top of those schemes where applicable.

6 – THALES

Although, this is of interest, we have no clear view of what to propose

7 – CATT

For VSAT like UEs, power consumption is not a big issue.

This only make sense for some handsets, especially for IoT NTN UEs.

<p>8 – vivo Mobile Communication Co.</p> <p>For power reduction for NTN devices, we support to include this in Rel-18 eNR-NTN objective. From the UE perspective, power saving is crucial for NTN device to prolong battery life.</p>
<p>9 – Guangdong OPPO Mobile Telecom.</p> <p>Power consumption is very important for terminal devices. We support this objective.</p>
<p>10 – MediaTek Inc.</p> <p>”Power reduction” is potentially misleading.</p> <p>If this is about Power Consumption, we do not see any NTN-specific work is necessary</p>
<p>11 – Samsung Electronics Co.</p> <p>We can consider based on the power saving features up to Rel-17.</p>
<p>12 – Rakuten Mobile</p> <p>Objectives and need for separate work item is unclear to us</p>
<p>13 – InterDigital</p> <p>Support as secondary objective. We see the primary use-case for power saving enhancements is to support a discontinuous coverage scenario. Although this has not be addressed in-depth in NR-NTN so far, it has been in IoT-NTN. We think we could adopt the eventual solutions from Rel-17 IoT NTN as baseline to save time. Lead WG: RAN1 or RAN2 Secondary WG: RAN2 or RAN 1</p>
<p>14 – Ericsson LM</p> <p>We are OK to study this.</p>
<p>15 – Sony Corporation</p> <p>Especially for NTN-TN service continuity, limit unnecessary measurements of TN frequencies when UE is out of TN coverage.</p>
<p>16 – Fraunhofer IIS</p> <p>Power reduction can be applied like in classical terrestrial NR so no specific prioritization is need from our point of view. As Samsung stated, work should be based on power saving features up to Rel-17.</p>
<p>17 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We don’t think power saving should be the main target for Rel-18 NTN evolution. We suggest to focus on enabling services which can be more competitive than the other existing satellite techniques outside 3GPP.</p>

Feedback Form 12: Regenerative Payload with Inter-Satellite Link (ISL)

1 – Omnispace

- Regenerative Payloads

A specific payload architecture should not be mandated as it is in Rel 17 (Transparent), We believe the support of regenerative payloads is very desirable. Such architectures may include full gNB on the satellite as well as the vRAN, CU/DU split, and O-RAN based initiatives that are already in common use in the terrestrial world. Such flexibility will be required in order to optimize ISL and Gateway bandwidth as well as system efficiency

2 – Classon Consulting

for FUTUREWEI TOP#1 item to be scoped out further, likely to be led by RAN2/3.

3 – Intelsat

We generally support the study of the regenerative payload in part due to its applicability to HAPS. At least an understanding of the tradeoff between different architectures may be helpful.

4 – Qualcomm Incorporated

This objective seems to have bundled two parts: Regenerative payload and ISL. We are neutral for regenerative payload. However, while we think ISL may be useful when satellite constellations get dense enough, we think it is too early to focus on inter-satellite links.

5 – ZTE Corporation

For the regenerative payload, we are fine to take it in Rel-18 but with limited architecture. For example, the full-gNB on board should be prioritized and benefits on cost/complexity for others should be further checked.

For the ISL part, the scope is not clear. Do we need to specify the design of whole interface including PHY related aspects since this part is up to the implementation.

6 – Asia Pacific Telecom co. Ltd

We support ISL discussion.

However, it may be too early to limit its scope by regenerative payloads.

7 – Gatehouse Satcom A/S

Agree with OMNISPACE that is important to have the possibility of having different payload architectures, where clearly regenerative payload is an architecture that is desirable and an enabler for the introduction of new services that are not depended on the size of the satellite constellation (no continues coverage need), and can be used for coverage within areas that are challenging or impossible to utilize via transparent payload without backhauling via GEO or ISL links.

ISL scope should be looked seperately from regenerative payload. ISL scope needs to be clarified first.

8 – Lenovo (Beijing) Ltd

Regenerative payload can reduce the network latency, and we are fine to support it. Enhancements on ISL and RAN3 interfaces may be necessary considering limited capacity of ISL. For the regenerative payload the issues due to feeder link switch should also be solved.

9 – China Mobile Group Device Co.

If time allow, we are fine to discuss the applicability of all R17 enhancements under the regenerative architecture.

10 – Beijing Xiaomi Mobile Software

We share the view that the ISL is not directly linked to the regenerative case.

11 – Apple Benelux B.V.

We feel this should be one of the main item for R18 as indicated in our initial round feedback.

12 – THALES

At this stage, it is unclear which architecture is preferred among gNB, DU, IAB node or other split on board.

This highly depends on the constellation design, space craft size/power and targeted services

Further discussion is needed to understand which architecture option should be prioritised for the commercial needs instead of embracing all options at once. Besides, it is not clear what 3GPP should do wrt to ISL.

13 – CATT

Regenerative payload architecture is desirable which could provide more choices to operators and make the deployment more flexible. And we assume there'll be very limited delta on the specification work compared to Rel-17 transparent architecture.

In a satellite network with limited worldwide ground stations, ISL shall be used to provide backhaul connection. The ISL could be provided by satellites on different altitude of orbits, and could be multi-hops. Following issues may need to be considered when the backhaul connection is over ISL:

1. TNLA change due to backhaul change: if the gNB on-board changes the backhaul connection, e.g., from feeder link to a ISL provided by another satellite, the TNLA between gNB and AMF needs to be re-established,
2. service interruption caused by backhaul change; the UP path may not be available before during the backhaul link change, e.g., from feeder link to a ISL provided by another satellite.

14 – Guangdong OPPO Mobile Telecom.

Regenerative payload with ISL is an important scenario for NTN deployment and not discussed in Rel-17. We support discussing it for NR-NTN in Rel-18.

15 – DOCOMO Communications Lab.

We share view with companies that regenerative payload with ISL is an important topic for NTN for robust network. In addition, this topic is beneficial for HAPS NW.

16 – Panasonic Corporation

We support this item for ISL.

17 – Spreadtrum Communications

We support that the regenerative payload should be considered in R18.

18 – MediaTek Inc.

Support for regenerative architecture is important in Rel-18

19 – Samsung Electronics Co.

The full advantage of regenerative payload cannot be utilized and the actual coverage of a satellite constellation is not extended compared to transparent payload. RAN WG3 will first discuss on which architecture will be used for regenerative payload among 1) gNB at sat (adaptation may be needed in NG), gNB-DU at sat (adaptation may be needed in F1), and 3) IAB-like sat (possible to support multi-hop routing, but large spec impact).

20 – InterDigital

Down prioritize. We think the focus of this WI should be on refining the existing deployment scenarios (e.g. transparent LEO/GEO) to increase support for devices with varying capability and seamless integration between TN and NTN. The specification effort to include new deployment scenarios and support for ISL links, which we do not think is trivial, could risk taking up a large amount of time and delay other efforts we consider more important from an adoption/user-experience perspective.

21 – Rakuten Mobile

We support ISL and regenerative Payloads; True Global LEO coverage can only be ensured with ISL.

22 – Intel Corporation SAS

In our understanding regenerative satellite with ISL can improve efficiency of NTN communication (e.g. reduced latency, better availability, etc.). Considering that regenerative payload scenario was considered in SI phase, we support to continue work on it in Rel-18.

23 – LG Electronics France

To introduce multi connectivity in NTN, ISL should be considered to communicate directly between LEO satellites. Furthermore, if regenerative payload is used, the propagation delay can be reduced.

24 – Ericsson LM

Different NTN architecture alternatives were already studied at length in Rel-16 and they are all documented in TR 38.821 . There is no need for a new study, as we can reuse the conclusions of that study. As we never specify multiple alternatives for architecture, we need to select a single one. According to TR 38.801 there are no showstoppers for the full gNB on board, whereas there will be impacts to existing interfaces and protocols which are already used for TN if we go for a split option. For this reason, we support the full gNB on board option for Rel-18.

25 – Ericsson LM

Typo: the correct TR is TR 38.821. Apologies for that.

26 – Sony Corporation

We think scope of ISL part is not yet clear.

It would be better to separate regenerative payload and ISL.

27 – Fraunhofer IIS

From our point of view, regenerative payload and ISL give much higher flexibility for deployments of 5G-NTN and evaluation of best suitable CU-DU split option (e.g. CU on ground & DU on board of satellite) can be a first step.

28 – HUAWEI TECHNOLOGIES Co. Ltd.

- We are supportive to specify regenerative payload since this can extend the service coverage to areas where gateway cannot be deployed, e.g. deep-sea maritime areas
- The main specification impacts may be in RAN2/RAN3 include down-selecting network architecture options and potential optimizations on setup/release/resume (for e.g. NG interfaces) due to feeder link switch.

Feedback Form 13: Enhanced beam management**1 – Qualcomm Incorporated**

We see this feature as a simple enhancement to enable mobility between beams of a single satellite without the need to perform L3 mobility. Note that L3 mobility results in interruptions, which may be visible for some use cases (e.g. VoNR). This also directly relates to the “power reduction for NTN devices” topic. So, we support this and it should be prioritized.

2 – ZTE Corporation

This is an essential feature for LEO case and we need to specify it in RAN1 to ensure the continuous service and saving the overhead. The legacy progress is Rel-17 (if any) can be considered as baseline.

3 – Lenovo (Beijing) Ltd

Our view is that some leftovers from R17 should be considered for a satellite cell containing multiple beams, especially the beam measurement and reporting procedures to address the large signaling overhead problem in NTN.

4 – Beijing Xiaomi Mobile Software

This may be the leftover from the Rel-17 which is dependent on the outcomes of the Rel-17 NTN WI. This should be led by RAN1 if supported.

5 – Apple Benelux B.V.

We are OK to consider enhanced beam management, e.g. for FR2

6 – THALESJustification (commercial needs)

Revisit the procedures for data-driven beam management and BWP optimization.

Since BWP is the primary method to partition carrier bandwidth and accommodate multiple numerologies and UE types with different DL bandwidth capability, this flexibility should be preserved for operators, on top of allowing the use of BWP to manage multiple beam configurations and arbitrary frequency reuse.

Objective

Preliminary study on whether existing legacy beam procedures (defined up to Rel-17) are insufficient would be needed before identifying the necessary spec impacts.

For this reason, we don't think this should be addressed in priority.

Involved WGs

Leading : RAN1

Secondary : RAN2

Potential impact to SA/CT

None

7 – CATT

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

8 – Guangdong OPPO Mobile Telecom.

Beam management is important for NTN deployment, especially for frequency reuse case. It is still under discussion in RAN1, but may be risky for completion in Rel-17's timeframe. If no chance to specify in Rel-17, we think it should be in the Rel-18's scope.

9 – DOCOMO Communications Lab.

We do not prefer so large scope in Rel-18 NTN, in this sense, firstly RAN1 should focus on Rel-17 NTN for this topic.

10 – Spreadtrum Communications

We are fine to further enhance beam management based on the outcomes of the Rel-17 NTN WI.

11 – MediaTek Inc.

Dependent on Rel-17 outcome!

12 – Rakuten Mobile

Object and Use case is not clear to us.

13 – Intel Corporation SAS

In our view enhancements for beam management is not essential optimization and can be considered in future releases after Rel-18.

14 – LG Electronics France

As lively discussed in the Rel-17 NTN, current NR spec is flexible enough to support beam management in NTN.

15 – Ericsson LM

We believe the baseline functionality in current specs is sufficient to realize e.g. flexible reuse schemes. Enhancements were discussed at length in Rel-17 and there was no consensus, so we should not spend precious time on this.

16 – HUAWEI TECHNOLOGIES Co. Ltd.

- We see the need to support of enhanced beam management in particular when NR-NTN deployment above 10 GHz bands is to be supported. This was discussed in Rel-17 NR NTN but unlikely to be converged.
- One important direction is to enable more efficient satellite beam switching with reduce measurement and reporting effort in case of LEO deployment

17 – NOVAMINT

It is an important topic worth to be addressed in release 18

Feedback Form 14: Introduction of new bands in release-independent manner

1 – Intelsat

This is somewhat aligned with NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE. Support for bands above 10 GHz (Ka, Ku, Q/V) is very important.

2 – Qualcomm Incorporated

We do not see the need to explicitly agree on this, a RAN4 basket work item can be used for this purpose (as done with other features)

3 – ZTE Corporation

It's RAN4 topic and we can check it later with other topics.

4 – Gatehouse Satcom A/S

Since new bands introductions are very depended on (local) governmental regulations, or spectrum licenses, and at the same time need to be technically feasibility in relation to link-budget and co-existence, it is important to plan the introduction within RAN4 as release-independent.

5 – Lenovo (Beijing) Ltd

We are generally fine with it.

6 – Beijing Xiaomi Mobile Software

At this stage we think it may be a RAN4-dedicated topic, not sure if it should be discussed here.

7 – Apple Benelux B.V.

We support this

<p>8 – THALES</p> <p>For below 6 GHz bands, a release independent WI is sufficient leveraging on the framework defined for S band as part of the Rel-17 NR-NTN-solutions WI</p> <p>As per bands above 10 GHz, see topic “NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE” above</p>
<p>9 – CATT</p> <p>We are generally fine with it.</p>
<p>10 – Guangdong OPPO Mobile Telecom.</p> <p>NTN new bands can be handled in RAN4 with usual approaches like NR new bands.</p>
<p>11 – DOCOMO Communications Lab.</p> <p>No need to discuss RAN4 topic here.</p>
<p>12 – MediaTek Inc.</p> <p>Can be handled normally by RAN4.</p>
<p>13 – Samsung Electronics Co.</p> <p>In general, this is a common practice in 3GPP and we are fine with such principle.</p>
<p>14 – Rakuten Mobile</p> <p>We are generally positive on this but this discussion should happen in RAN4.</p>
<p>15 – Ericsson LM</p> <p>We believe 3GPP should not specify its own bands, so we should work within the allocation done by the appropriate organizations.</p>
<p>16 – Fraunhofer IIS</p> <p>This question is related to the question about NR-NTN deployments above 10 GHz and we agree with Thales. To be evaluated is the impact for FDD in bands above FR1.</p>
<p>17 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We think this should be RAN4 routine work based on operator requirement.</p>
<p>18 – NOVAMINT</p> <p>We support the point and views made by Thales</p>

Feedback Form 15: Study of DL PAPR reduction (new waveforms should not be considered in Rel-18)

1 – Intelsat

The degradation in performance due to high PAPR in the DL, in particular for CP OFDM, is an important consideration for Release 18. Methods that improve the DL PAPR can enable higher performance and lower cost. We support the study of methods, including the applicability of DFT-S-OFDM for the DL, as an important activity.

2 – Qualcomm Incorporated

Although we are aware of the potential benefits of having a new waveform, the priority of this item should be carefully assessed (also, the potential of not being backwards compatible with Rel-17 is a concern to us). Focusing on alternative techniques (e.g. tone reservation for PAPR reduction) could be considered as an alternative.

3 – ZTE Corporation

We are open to this topic but with lower priority comparing to other aspects. Meanwhile, in addition to the performance improvement, the complexity at both gNB and UE side should be one important factor.

4 – Lenovo (Beijing) Ltd

We prefer this is treated with lower priority due to large spec impact on waveform selection, design, etc.

5 – Beijing Xiaomi Mobile Software

We are open to discuss this topic. This may mainly impact the Satcom operator/manufacturer. Maybe they can share more views on how severe this issue could be.

6 – Apple Benelux B.V.

Without new waveforms, the scope of this item is unclear and therefore, we prefer it to de-prioritize this item. We do not support new waveform introduction due to the impact on R17 devices.

7 – THALES

Justification (commercial needs)

High PAPR causes significant power efficiency loss and consequent throughput loss. Satcom operators will be either forced to deploy a non-standard system or not deploy the system at all if this is not addressed in some way.

Issue has been identified both at FR1 and FR2, but due to typical payload architectures it is more significant in FR2 (above 10 GHz) - for transponder configurations of small number (<3-4) of OFDM channels per HPA, the throughput degradation may be severe. However, PAPR alone is not a sufficient metric. OOB is also a significant player even in configurations with large number of carriers per-HPA, where carrier PAPR is less problematic.

It should be noted that high power fluctuation of CP-OFDM waveform affects all payloads in the forward link due to gain compensation/compression that may be necessary to normalize the PAPR to some extent even at lower frequency bands.

Note that UL already enables DFT-s-OFDM.

Objective

Define DFT-s-OFDM based waveform on DL. [RAN1]

Define signalling to ease the implementation of PAPR mitigation techniques on DL. [RAN1, RAN2]

Involved WGs

Leading : RAN1

Secondary : RAN2

Potential impact to SA/CT

None

8 – 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 optimization for PAPR reduction or new waveform.

9 – Guangdong OPPO Mobile Telecom.

We don't see a strong motivation to support this feature.

10 – DOCOMO Communications Lab.

This topic would need many spec impact. All DL channels/signals will be enhanced. Unless really needed/prioritized compared to other topics, this topic should be set as low priority.

11 – Panasonic Corporation

We support this item to suppress performance degradation.

12 – MediaTek Inc.

We see no strong motivation for this work in Rel-18, as explained earlier.

13 – Samsung Electronics Co.

We think this can be handled totally gNB and satellite implementation issues.

14 – Intel Corporation SAS

Implementation-based solutions can be used for PAPR reduction. In our understanding there is no urgent need to specify enhancements in Rel-18.

15 – LG Electronics France

This issue can be studied, but prefer to postpone in later release.

16 – Eutelsat S.A.

DL PAPR improvement is one of the most important improvements that could be made on the DL for R18 - for example, it directly enables higher EIRP without power consumption penalty and therefore, can be used to improve the down link budget. Please also see our initial response for further explanation.

17 – Sony Corporation

We think major PAPR reduction on DL can be gained by adopting DFT-s-OFDM on DL but we also agree that PAPR reduction techniques can be useful for the CP-OFDM DL.

18 – Fraunhofer IIS

DL PAPR reduction is mandatory for operators in the satellite domain especially for high throughput use cases and we do not consider it only as study, but as a normative work item. Using the DFT-s-OFDM as already specified in UL also for DL we consider as feasible within Rel-18.

19 – NOVAMINT

We support the point and views made by Thales

20 – HUAWEI TECHNOLOGIES Co. Ltd.

We don't support study of DL PAPR reduction in Rel-18.

- DL PAPR reduction was discussed in Rel-16 SI but it was concluded that it can be done by implementation-based solutions. We are wondering what has been change since then.
- In addition, PAPR is not the only performance metric and other performance metric such as BER, data rate and implementation complexity should also be considered.
- Overall, we don't see the urgency to study DL PAPR reduction in Rel-18 NTN considering that any changes to waveform will require quite substantial specification effort.

Feedback Form 16: Study of UE without GNSS

1 – Classon Consulting

for FUTUREWEI Do not support including this objective.

2 – Qualcomm Incorporated

Although this enhancement can be useful, we are not entirely sure if it is urgent (all smartphones have GNSS receivers, and power consumption is not as critical as in the IoT case).

3 – ZTE Corporation

It's better to clarify the scope. In our views, there are different level on the assumption regarding the GNSS including GNSS-capable with good quality (e.g., in Rel-17),GNSS-capable with poor quality and GNSS-incapable. For the 2nd one, the required improvement for UL synchronization is controllable based on the legacy pre-compensation mechanism. But for the 3rd one, additional efforts may be needed to re-design the solution. Then, we prefer to prioritize the assumption as "GNSS-capable with poor quality' firstly.

4 – Lenovo (Beijing) Ltd

GNSS capability is one of the UE restrictions in Rel-17 NTN. Such restrictions are expected to be eased hence allowing Rel-18 NTN to support a wider range of UE capabilities and use cases. Enhancements may be needed on time/frequency synchronization, initial access, etc. Therefore, we prefer it to be treated as a higher priority.

5 – China Mobile Group Device Co.

For R18 NTN, UE without GNSS or pre-compensation capability needs to be discussed, i.e. how to obtain UE location info. As we mentioned in feedback form 10, network based UE location is beneficial for both NTN and IoT-NTN to obtain UE location info. And other solutions for UE location acquisition could also not be excluded.

6 – Apple Benelux B.V.

This is one of our priority items for Rel-18 as already indicated in the initial round.

7 – Beijing Xiaomi Mobile Software

We are open to discuss it. The scope should be more clear.

8 – THALES

Justification (commercial needs)

Improve UE energy efficient and reduce dependency to GNSS service availability; support of low cost UEs for both NR and LTE based IoT radio protocols

Objective

Only a study phase would be carried out with the aim to identify the possible impacts at RAN1 and RAN2 level of serving UE without GNSS capabilities (either no GNSS receiver or GNSS not used for operating with satellite access).

In particular, the following should be considered:

New method for UL time & frequency sync in idle and connected mode, New PRACH [RAN1, RAN2]

Coexistence analysis of UE with & without GNSS in a given cell [RAN4-RD]

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

Involved WGs

Leading : RAN1

Secondary : RAN2, RAN4, RAN3

Potential impact to SA/CT

PLMN and core network selection/registration and possibly on LCS

9 – CATT

CATT is supportive to include this objective, maybe this could be merged with objective “Network based positioning”, the new objective could be named “Positioning enhancement for NR NTN”.

10 – Guangdong OPPO Mobile Telecom.

We support study of UE without GNSS as Rel-17 assumes GNSS only.

11 – Panasonic Corporation

We support this item for NTN service continuity even in a circumstance where a UE cannot get a GNSS signal.

12 – DOCOMO Communications Lab.

This topic can be high priority from perspective of market demands. Better availability of NTN (including HAPS NW) can be achieved. For example, indoor UE, GNSS-incapable UE, UE in GNSS-unreliable UE (e.g. urban area with high-rise building).

13 – MediaTek Inc.

We do not support this objective. Rel-17 assumption of UE GNSS capability holds.

14 – MediaTek Inc.

Generally we are also concerned a fundamental point is not being included in the summary (there is NO way to stress this in a general section as there is no such thing): HD-FDD based on RedCap while avoiding BW/antenna restrictions - It is very important to enable a single device availability across all NTN bands.

15 – Samsung Electronics Co.

Without GNSS capability at the UE side, Rel-17 NTN cannot be utilized because Rel-17 NTN is based on the assumption of GNSS positioning. But low cost terminals and for the case of weak GNSS signal may not be capable of GNSS positioning. In order to scale up the range of users that can access NTN, the related enhancement is necessary. This might have large spec impact since new PRACH format, new TA mechanism, and new handling of Doppler shift are needed.

16 – InterDigital

Support as secondary objective. We would like to support non-GNSS UEs **ONLY** from the perspective of using network-based UE location as a substitute for GNSS. We have an existing framework which relies heavily on UE location information for e.g. pre-compensation, CHO, measurements etc.. and think that redesigning these aspects for a device which can access NTN but not GNSS is not well motivated. Lead WG: RAN1/RAN2.

17 – Intel Corporation SAS

In our view support of UEs without GNSS is not sufficiently well motivated to be included in the Rel-18 NTN. It is not clear what is the percentage of such UEs in the deployment. Also, support of UEs without GNSS will lead to degradation of system performance due to longer duration of PRACH reception window. Also, new PRACH design and closed-loop frequency control should be specified to support UEs without GNSS, it requires significant standardization efforts.

18 – LG Electronics France

This issue can be discussed, but we are afraid because it needs too much discussion because R17 NR NTN discussion assumes GNSS-capable UEs. So the enhancements in R17 NR NTN such as NTN CHO or idle mode mobility is based on GNSS-capable UEs. So if we study the UEs without GNSS capability, we should study the enhancements from the start.

19 – Eutelsat S.A.

We support a study on UE/devices without GNSS covering both NR and IoT-NTN. Poor quality GNSS output (degraded operation) should also be considered as an enhancement to GNSS capable R17 UE/ devices and capable/ non-GNSS UE/devices from R18 onwards.

20 – Ericsson LM

As previously commented, today's NTN UEs typically do GNSS to ensure a prompt network attach, so it seems like an accepted implementation. We do understand the desire to reduce UE complexity, but we should consider that also terrestrial UEs, are subject to the same trend (and by the way they typically include GNSS). The "natural" benefit of GNSS for NTN is that it does not require to introduce NTN-specific network-based positioning methods (today's specified methods assume TN geometry, and this makes them inapplicable to NTN). So, we question the relevance of this proposal.

21 – Sony Corporation

In our view, all Rel18 NTN UEs should have GNSS capability. We think it is too early in Rel18 to study UEs without GNSS capability.

22 – Fraunhofer IIS

We agree with Panasonic, Apple, Lenovo and other companies to address UE without GNSS in Rel-18, as study and minimum normative work. Objective is to not limit the number and variety of connected devices.

23 – NOVAMINT

If this is addressed by Release 18, it should be a study only and it should include IoT as well

24 – HUAWEI TECHNOLOGIES Co. Ltd.

We don't support UEs without GNSS in Rel-18 given this is the fundamental assumption for Rel-17 design in both physical layers and higher layers. Our concerns have been raised in the first round of discussion

- It seems a common understanding that a Rel-18 UE without GNSS cannot get access to a Rel-17 NTN network. The potential cost reduction and potential power consumption reduction due to no GNSS may not justify the limitation of not being able to access Rel-17 NTN network.
- In Rel-17 NTN, UE location is mandatory for UE to get access to the core network, i.e., the User location is needed for RAN to select the AMF CN. If UE GNSS information is not available, some other location mechanism(s) must be introduced, which may require considerable standard effort (if at all feasible)

2.1.2 Evolution of IoT (Internet of Things) NTN

Feedback Form 17: Limited IoT-NTN scope in Rel-18 (focus primarily on remaining issues from Rel-17 and incorporating relevant enhancements from Rel-17 NR-NTN)

1 – Classon Consulting

for FUTUREWEI OK, but should also discuss more what the specific "remaining issues" are and if they are essential for rel-18. We may want to focus the bulk of our efforts on NR-NTN.

2 – Qualcomm Incorporated

It is unclear what this means. We would support a limited IoT-NTN scope focusing on essential issues that have a clear impact on deployment scenarios and performance (in terms of data rates, duration of connection, and/or power consumption).

3 – ZTE Corporation

We are in general fine with this principle but the detailed scope should be further clarified to address the essential issues including HARQ enhancement, UE density, power consumption, and long transmission case.

4 – Gatehouse Satcom A/S

It is important to have the Rel-17 base supported to enable the (new) service potentials. If this requires the continuation in a Rel-18 scope, then this can be seen as priority. Additionally to this, the scope of Rel-18 can continue additional items that improve overall systems efficiency and power performance, since these areas have been only limited in the Rel-17 focus and are critical to enable general IoT expectations/scenarios.

5 – Lenovo (Beijing) Ltd

Considering limited time in Rel-18 IoT NTN, it should be prioritized to solve any remaining issues from Rel-17, wherein only minor enhancements are considered necessary.

6 – China Mobile Group Device Co.

R18 IoT-NTN should solve the remaining issues of R17 firstly due to limited time for discussion in R17.

7 – Apple Benelux B.V.

If limiting the scope is the consensus view, we are ok to consider it provided discontinuous coverage is a pending R17 item.

8 – Beijing Xiaomi Mobile Software

Not sure about the "remaining issues" refers to. In our understanding, the mobility, power consumption and UE without GNSS should be considered in Rel-18

9 – THALES

Remaining issues may include full support of discontinuous coverage (including SA level: e.g. paging, PSM), deployment in new bands.

10 – Spreadtrum Communications

We are fine with this principle. The non-essential functionality (power consumption, spectral efficiency, high throughput, mobility, etc.) identified in Rel-17 should be considered firstly.

11 – CATT

CATT is ok with this. For IoT NTN, we should focus on Rel-17 work for now.

12 – NEC Corporation

Ok. Scope should depends on whether Release-17 NTN IoT can significantly benefit from additional enhancements in some scenarios and use cases.

13 – Guangdong OPPO Mobile Telecom.

We support discussing remaining issues of Rel-17 in Rel-18.

14 – MediaTek Inc.

We would like to stress once more that this work ought to focus on:

- **Disabling of HARQ feedback** to mitigate impact of HARQ stalling on UE data rates
- **Improved GNSS operations** for a new position fix for UE pre-compensation during long connection times
- Support of **(Rel-17) neighbour cell measurements** and corresponding measurement triggering before RLF for NTN
- Support of **(Rel-17) NB-IoT carrier selection based on the coverage level**, and associated carrier specific configuration for NTN.
- Support **legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment mechanisms for NB-IoT NTN** to mitigate packet interruption for NTN to mitigate packet interruption for NTN

15 – Samsung Electronics Co.

We agree on a limited scope of NTN-IoT in Rel-18, but which Rel-17 leftovers and enhancements from Rel-17 NR-NTN to be adopted need to be clarified. HARQ enhancements can be considered.

16 – InterDigital

Support as primary objective. Considering that down-scoping was necessary to complete IoT NTN in Rel-17 timeframe, it would make sense to refine the feature in Rel-18 to incorporate aspects that were left out/useful solutions from NR NTN e.g. mobility enhancements, disabling HARQ. Lead WG: RAN1/RAN2.

17 – Intel Corporation SAS

Support. Details can be discussed after Rel-17 IoT NTN WI is completed.

18 – Eutelsat S.A.

As commented in the initial round, Rel-17 for IoT NTN will be a minimal release with essential functionality and Rel-18 will have to include a number of leftover capabilities that would e.g. further reduce power consumption, improve spectral efficiency, resources usage and more generally IoT service provision over NTN for the considered deployment scenarios. Please also see our comments on the specific IoT NTN topics below.

19 – NOVAMINT

Only a limited effort was possible in Release 17 and release 17 will be a minimal release with essential functionalities for a first version.

So, Release 18 should address the leftovers of release 17 (further power reduction to support discontinuous coverage, mobility enhancements...) but as well features which can allow to be competitive at the time where Release 18 will be commercialised such as the support for store-and-forward on-board NTN payload.

20 – Ericsson LM

We are OK with this in principle, but we will need a serious scoping exercise to specify exactly what this includes.

21 – Sony Corporation

It is unclear what the proposal means.

Our understanding is that the remaining issues from Rel-17 are those issues that were considered in the Rel-17 IoT-NTN study item but were not carried forward into the Rel-17 work item as the Rel-17 work item focused only on minimum essential functionality.

As also commented by other companies, we think that Rel-18 should focus on issues of throughput, latency, capacity, coverage and battery lifetime.

22 – VODAFONE Group Plc

As said in the 1st round, discontinuous coverage support would be useful to add.

23 – Sateliot

Unclear what this proposal actually means

In any case, we think that Rel-18 should address the leftovers of Rel-17 (e.g. further enhancements for the support of discontinuous coverage) as well as a number of key enhancements and new capabilities (as listed in the other elements of this discussion) relevant for market needs.

24 – HUAWEI TECHNOLOGIES Co. Ltd.

We are in general fine with this and our understanding is mainly the HARQ disabling was not supported in IoT-NTN.

Feedback Form 18: Mobility enhancements**1 – Qualcomm Incorporated**

Small enhancements based on already existing features e.g. CHO for eMTC NTN could be considered. But we do not see a need to add any mobility or mobility enhancement feature for NB-IoT NTN. If we

want to proceed with this item, we may want to focus our attention on "beam-level mobility", similar to the discussion in NR NTN.

2 – Spreadtrum Communications

We agree that mobility enhancements need to be considered in R18 IOT NTN. In particular, multiple satellite beams in one IOT NTN cell and beam based mobility management should be considered to avoid frequent cell handovers.

3 – ZTE Corporation

This topic is not critical for IoT-NTN and we prefer to postpone once the issue has been identified after the initial commercial deployment.

4 – Gatehouse Satcom A/S

This area should increase the efficiency of the Rel-17 NTN functionality, by reducing signaling overhead, to enable further commercializing of NTN services.

5 – Lenovo (Beijing) Ltd

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.

6 – Apple Benelux B.V.

Additional cases that impact LTE based IoT NTN mobility if needed should be treated very carefully depending on the use cases.

7 – Beijing Xiaomi Mobile Software

We support to discuss this in the Rel-18 IoT NTN and it should be led by RAN2.

For IoT mobility, we think following objectives can be considered:

- Solutions introduced in Rel-17 NR NTN can be considered, such as location based CHO and timing based CHO;
- Reduce handover signaling overhead
- RACH congestion reduction
- Enhancements on RLF and RRC reestablishment
- IoT-NTN and TN mobility enhancement

8 – THALES

Justification (commercial needs)

Optimize mobility signalling overhead and efficiency to avoid cell change when beam changes.

Objective

Beam-based mobility / Multiple satellite beams in one cell. [RAN1, RAN2]

CHO enhancement in connected mode. [RAN2]

Network-controlled mobility. [RAN2, RAN3]

Layered beam operation. [RAN1, RAN2].

Neighbour cell measurements and corresponding measurement triggering before RLF. [RAN2]

Involved WGs

Leading : RAN2

Secondary : RAN1, RAN3

Potential impact to SA/CT

Mobility/session mobility

9 – CATT

Generally, we are ok to work on Mobility enhancements in NR NTN Rel-18.

However, the target should be clarified, i.e. what to be enhanced for NTN-TNandNTN-NTNmobility.

10 – NEC Corporation

We agree that at least CHO for eMTC can be considered.

11 – Guangdong OPPO Mobile Telecom.

These are not well addressed in Rel-17 and should be further studied in Rel-18.

12 – Samsung Electronics Co.

Not high priority for Rel-18.

13 – MediaTek Inc.

- Support of **(Rel-17) neighbour cell measurements** and corresponding measurement triggering before RLF for NTN.
- Support **legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment mechanisms for NB-IoT NTN** to mitigate packet interruption for NTN to mitigate packet interruption for NTN

14 – InterDigital

Support as secondary objective. Could take Rel-17 NR-NTN mechanisms as baseline and adapt to LTE.

Lead WG: RAN2; Secondary WG: RAN1.

15 – Intel Corporation SAS

We are supportive to consider mobility enhancements.

16 – NOVAMINT

Concerning mobility enhancements, we believe we need to focus on the specificity of NTN versus TN and the impact for IoT. In particular, it is important to address beam-based mobility and multiple satellite beams in one cell in order to optimise mobility signaling overhead and efficiency to avoid cell change when beam changes.

Leading: RAN2 / Secondary: RAN1, RAN3

17 – Ericsson LM

We are OK with this in principle as long as the basic foundation (including IoT principles) stays the same. Also in this case, some serious scoping will be needed.

18 – Sony Corporation

Support work on mobility enhancement.

An issue specific to IoT-NTN that was identified in the Rel-17 SI was that for a LEO deployment, a UE may not be able to transmit all of its repetitions before changing to a different cell / satellite beam. The Rel-18 WI should hence consider mobility for long PUSCH / PDSCH transmissions.

Objective

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

19 – Sateliot

Support work on mobility enhancements.

This will allow for more resource efficient beam layout configurations at the satellite level and optimize mobility signaling overhead and efficiency to avoid cell change when beam changes.

20 – HUAWEI TECHNOLOGIES Co. Ltd.

For mobility enhancement, we think the Rel-17 leftovers such as potential enhancement to cell selection/re-selection, CHO and RLF/reestablishment for IoT-NTN (if not specified in Rel-17) can be considered. The other enhancements should be of second priority.

Feedback Form 19: Further enhancement to discontinuous coverage**1 – Qualcomm Incorporated**

Although this topic is being discussed in Rel-17, it is unclear how far RAN will be able to go without changes in the core network. We would support having some further work in Rel-18 to reach a more optimized solution.

2 – Spreadtrum Communications

We agree that further enhancement to discontinuous coverage should be considered in R18 IOT NTN.

3 – ZTE Corporation

We are supportive to discuss this topic and further evaluation with corresponding assumption should be

done firstly.

4 – Gatehouse Satcom A/S

Improvement of energy consumption on the UE side is important, as well the optimization of capacity and link resources for discontinuous coverage. To achieve this, alignment on system level is critical, meaning aligned implementations within RAN, SA and CT are seen as critical.

5 – Lenovo (Beijing) Ltd

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. In Rel-18 UE-NW interaction and UE power saving based on the assistance can be further studied to avoid unnecessary power consumption and enable accurate connection recovery.

6 – Apple Benelux B.V.

As indicated in our initial round we are supportive of the discontinuous coverage. We also feel this is a straight forward extension of pending R17 items.

7 – Beijing Xiaomi Mobile Software

We support that this should be within the Rel-18 scope as in the initial deployment scenario, the sparse deployed satellite cannot provide seamless coverage. 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. This should be led by RAN2, and RAN1 should be involved.

8 – THALES

Justification (commercial needs)

Improve energy consumption on the UE side and allow for inter-cell mobility in the discontinuous coverage case.

Important to consider to have a dynamic support of discontinuous coverage (this is not only relevant for initial constellation but as well to support evolution of the constellations such as loss of satellites, different releases supported in a given constellation...). There is an important aspect of discontinuous coverage related to dynamic GEO systems where beams/cells are intermittent due to use of dynamic beam configuration. In this scenario the dwell time of a beam is not directly correlated with orbit prediction.

Objective

Efficient power saving mechanisms (iDRX/PSM) for sparse satellite constellations.

Improvements to UE mobility among sparse cells.

Network-controlled mobility and multiple non-anchor carriers may be taken into account.

This scope and its priority should however depend on the progress in Rel-17 IoT-NTN WI

Involved WGs

Leading : RAN2

Secondary : RAN1, RAN3

Potential impact to SA/CT

Enhancement to discontinuous coverage need to be studied by SA2 and CT1.

9 – CATT

Enhancement for discontinuous coverage may be useful for IoT NTN. However, this is pending to the output of Rel-17 WI.

10 – NEC Corporation

The enhancements in Rel-17 will not be enough to handle this case so we propose to focus on R17 leftovers (e.g., for RRC_CONNECTED state).

11 – Guangdong OPPO Mobile Telecom.

This is still under discussion in Rel-17. Whether it should be included in Rel-18 should depend on Rel-17's outcome.

12 – InterDigital

Support as secondary objective. We would like to refine this scope once more progress has been made in the Rel-17 IoT-NTN WI, however support in principle.

13 – MediaTek Inc.

Dependent on Rel-17 outcome, however a full system-wide solution is unlikely to take place in Rel-17 and may only address very low hanging fruit (e.g NAS timer extension to prevent undue expiry due to discontinuous coverage). Rel-18 improvements likely required.

14 – Eutelsat S.A.

Even though changes are contemplated in Rel-17 for ensuring proper support of discontinuous coverage, and some minimal alignment work is expected in SA2 specifications, some features (e.g., PSM, eDRX) are instrumental in supporting IoT services efficiently, and enhanced means to improve synchronisation between the Access Network and the Core Network may be needed. Also, enhanced means to support satellite flyover predictions and coordinated UE wakeup w.r.t. Rel-17 capabilities may be considered.

15 – Intel Corporation SAS

We are supportive to consider enhancement to discontinuous coverage.

16 – Ericsson LM

We are OK to study this.

17 – NOVAMINT

This topic is to be linked to power savings including PUR.

The support of discontinuous coverage is key for IoT NTN as constellations may be sparse especially at the beginning or could have issues or different releases supported...

A first level of support of discontinuous coverage is currently addressed in principle in R17 in particular for PSM and eDRX. However, there are likely further enhancements to be done for PSM and eDRX and other power savings such as PUR to support discontinuous coverage in Release 18.

We suggest to have one objective “Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage”

Leading: RAN2 / Secondary: RAN1, RAN3

Enhancement to discontinuous coverage need to be studied by SA2 and CT1

18 – Sony Corporation

Support for discontinuous coverage is important for IoT-NTN. The Rel-18 WI can consider enhancements depending on the progress in Rel-17.

19 – HUAWEI TECHNOLOGIES Co. Ltd.

This needs to be discussed together with store-and-forward on-board NTN payload. We think there is a fundamental UE reachability issue which will impact core network. Other comments on store-and-forward on-board NTN payload can be found below.

Feedback Form 20: Support for store-and-forward on-board NTN payload

1 – Qualcomm Incorporated

This should be considered together with “discontinuous coverage”, where the coverage gap may be on the service or feeder link.

2 – ZTE Corporation

Not needed, if it refers to the re-generation payload. Otherwise, please clarify the intention.

3 – Gatehouse Satcom A/S

Store&Forward (regenerative payload) is desirable and an enabler for the introduction of new services that are not depended on the size of the satellite constellation (no continues coverage need), and can be used for coverage within areas that are challenging or impossible to utilize via transparent payload without backhauling via GEO or ISL links. Gatehouse sees this functionality as the main driver for Rel-18, and should be possible to be specified with limited RAN efforts.

4 – Apple Benelux B.V.

In our view this item should be treated in SA first.

5 – Beijing Xiaomi Mobile Software

Can be merged with “Feedback Form 19: Further enhancement to discontinuous coverage”

6 – Eutelsat S.A.

Strongly support work to support store-forward operation. As we said in the initial round, the primary benefit of Store-Forward is the reduction in ground segment – it reduces the number of ground-stations as data can be stored onboard the satellite until a feeder link is available. The RAN specification impact is significant (RAN1, 2, 3 but no impact seen on RAN4 RF parameters), and we would need to identify any SA and CN work, but the benefits are potentially very large.

7 – THALES

Justification (commercial needs)

An NGSO constellation typically requires several tens (MEO) or even hundreds (LEO) of satellites to provide service all over the Earth. Moreover, it requires that the constellation connects simultaneously a service area with a Core Network via a ground network infrastructure of gateways.

The support of store and forward capabilities will allow to start providing non real time IoT NTN services globally with only one satellite while reducing the required number of ground-stations which can be in deployed in ‘friendly’ locations.

The satellite need to embark eNB function and storage capability and will harvest data from IoT devices along its orbit and forward it to a core network when it encounters a NTN-GW. Conversely, it uploads data from core network when connected to a NTN-GW and delivers it to the relevant IoT-devices when covering the targeted service area. Store and forward allows IoT NTN service delivery in areas where the satellite is not, or cannot, be connected to a ground station when interacting with the UEs (i.e. “UE <-> satellite” signalling and data transfer shall be possible without the satellite being simultaneously connected to a central CN functionality on the ground).

This is important to have further cost effective and scalable solutions adopted by the market (in association with discontinuous coverage). Indeed, store and forward operation is already the native operation method used by other protocols (such as LoRa) competing for the low-cost satellite IoT market.

Objective

eNB on board is assumed.

Support of decoupled signalling procedures “UE <-> Satellite” and “Satellite < CN ground” for achieving end-to-end functionality. [RAN2]

Address dynamic attachment between S-GW and eNB. [RAN3]

Network identity handling, cell activation associated to moving RAN nodes. [RAN3]

Coordination with SA2. [RAN3]

UE’s power saving [RAN1, RAN2]

Involved WGs

Leading : RAN2

Secondary : RAN1, RAN3

Potential impact to SA/CT

Support of regenerative payload

8 – CATT

Considering discontinuous backhaul scenario, e.g. ISL lost, the gNB may lose the backhaul connection towards the 5GC temporarily.

In this case, store-and-forward may be used to avoid packet drop.

So it seems a kind of optimization on top of regenerative architecture, which could be further investigated in Rel-18.

9 – MediaTek Inc.

Not sure what this refers to

10 – Ericsson LM

This is up to satellite implementation (and even more so in a regenerative architecture, where the satellite is a logical node!), so we do not support this proposal.

11 – NOVAMINT

We believe this is the most important new feature for IoT NTN in Release 18 as in Release 17 only transparent mode was supported.

Concerning the use cases, we see this relevant for many and will anyway drive further cost effective and highly scalable solutions which is key for IoT and market adoption and for 3GPP to be competitive with other low-cost satellite IoT proprietary solutions having already adopted this model.

Leading: RAN2 / Secondary: RAN1, RAN3

12 – Sony Corporation

This is desirable functionality. It has linkages to discontinuous coverage and regenerative payloads. There may be SA involvement.

Feedback Form 21: Preconfigured Uplink Resource**1 – Qualcomm Incorporated**

Rel-17 WI is still not concluded and there is a possibility it may already be supported in Rel-17 at least for GEO. If not, we are open to consider it in Rel-18, for both GEO and LEO.

2 – Spreadtrum Communications

For LEO, taking into account the rapid movement of satellites, PUR transmission in R16 need to be enhanced. We are fine to discuss PUR transmission in R18 IOT NTN.

3 – ZTE Corporation

It's still pending in Rel-17. If no progress can be achieved, we are supportive to discuss it in Rel18.

4 – Lenovo (Beijing) Ltd

PUR is an important mechanism to IoT UE power saving. 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.

5 – Apple Benelux B.V.

Changes to LTE at this point are complicated in our view. Also, we prefer an equivalent mechanism for NR NTN.

6 – Beijing Xiaomi Mobile Software

We share the view that this is dependent on th Rel-17 outcomes.

7 – THALES

Justification (commercial needs)

Improve channel capacity and density of devices that can access to the satellite resources (alternative to NOMA).

Reduces UE power consumption and transmission latency by allowing the UE to transmit without undergoing full RACH procedure. May increase link budget, but this needs to be better understood.

Would also help with discontinuous coverage by shortening transmission time and increasing transmission capacity. However, there may be some improvements needed for PUR to support efficiently discontinuous coverage (transmission timing alignment).

Objective

PUR (Rel-16 NB-IoT feature) supporting NTN support addressing NTN specific delay and beam size. [RAN1, RAN2]

Enhancement to PSM, eDRX and PUR to to support discontinuous coverage [RAN2]

Involved WGs

Leading : RAN1

Secondary : RAN2

Potential impact to SA/CT

None

8 – CATT

We share the view that this is dependent on th Rel-17 outcomes.

9 – NEC Corporation

Generally support this and maybe we should identify use cases that can significantly benefit from PUR.

10 – Guangdong OPPO Mobile Telecom.

There are some discussions on preconfigured uplink resource for IoT-NTN in Rel-17. If it is not specified in Rel-17, we are fine to further discuss it in Rel-18.

11 – Eutelsat S.A.

The focus on PUR alone as an uplink improvement in R18 is far too limiting. We would support a study which takes a broader view on uplink improvements; we would further suggest this work could be included in any study of non-transparent satellite architecture options (including store-forward and regenerative payload).

Please see the response in the initial round for our view on PUR.

12 – Samsung Electronics Co.

Discussion is ongoing in Rel-17. If it is not concluded, it could be considered in Rel-18 but not with high priority.

13 – MediaTek Inc.

Dependent on Rel-17 outcome

14 – Intel Corporation SAS

Some discussion on PUR is ongoing for Rel-17 IoT-NTN WI (at least in RAN1). So, PUR can be supported in Rel-17 for NTN. Thus, we can discuss this item after Rel-17 WI completion.

15 – Ericsson LM

This has been discussed within the context of Rel-17 WI. It can be supported in GEO deployments, but for MEO and LEO in principle the mechanism does not work as specified for IoT TN due to frequent cell changes. For IoT TN, PUR configuration is released if the UE performs cell (re-)selection. So, its applicability to NTN is not as broad as it would appear.

16 – NOVAMINT

Linked to discontinuous coverage and power savings topics

PUR is efficient if there are several consecutive PURs not skipped - if not the device will release the PUR configuration and re request for another PUR configuration so in case of discontinuous coverage it may create this not to work as intended and with no real power savings.

So it would make sense to study PUR enhancements for IoT NTN to support discontinuous coverage”

We suggest to have one objective “Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage”

Leading: RAN2 / Secondary: RAN1

17 – Sony Corporation

PUR is still pending in Rel-17. At least PUR for GEO may be supported in Rel-17 with minimal specification impacts.

Feedback Form 22: Power reduction for IoT NTN devices**1 – Qualcomm Incorporated**

Battery consumption has been one of the key metrics for eMTC and NB-IoT. During the Rel-17 study it was recognized that GNSS acquisition results in a significant percentage of the overall used power – Rel-18 should alleviate this issue, by supporting operation without GNSS / with reduced GNSS usage, and

supporting HARQ disabling.

2 – ZTE Corporation

We are supportive on this aspect since it's critical for IoT device. We need further discuss the potential solution to optimize the power consumption including GNSS related behavior.

3 – Gatehouse Satcom A/S

Power efficiency for IoT is key (agree with QUALCOMM). Power reduction (UE) needs to be further in focus of Rel-18, as the focus of Rel-17 has been mainly in achieving IoT NTN communication, without possibilities to specify for efficiency and power usages as key parameters.

4 – Lenovo (Beijing) Ltd

Power reduction is always important to IoT devices. In NTN there could be more power consumption due to the large propagation delay, satellite movement or even coverage interruption. Enhancements can be considered both for idle and connected (mainly for mobility).

5 – China Mobile Group Device Co.

Power saving enhancement is necessary for IoT-NTN devices, which should be given first priority

6 – Apple Benelux B.V.

We are ok to support power reduction mechanisms. An alternate way to look at this item would be latency reduction schemes leading to power reduction on UEs.

7 – Beijing Xiaomi Mobile Software

We are supportive to work on the power reduction for IoT devices. This is also related to “Feedback Form 19: Further enhancement to discontinuous coverage”, and we think both RRC Connected and Idle UE should be considered for power reduction.

8 – THALES

We suggest to address this in relation to Preconfigured Uplink Resource topic.

9 – CATT

Could be considered for IoT NTN.

10 – NEC Corporation

We prefer to focus on R17 leftovers on HARQ enhancement, possible lead by RAN1/2.

11 – Guangdong OPPO Mobile Telecom.

Power consumption is very important for IoT devices. We support discussing powering saving enhancements for IoT-NTN in Rel-18.

12 – InterDigital

Down-prioritize. Primary use-case would be in discontinuous coverage scenario, and this is already covered by a previous question.

<p>13 – MediaTek Inc.</p> <p>This is totally open-ended hence not really actionable</p>
<p>14 – Eutelsat S.A.</p> <p>This should be considered for IoT NTN (including GNSS impact) as a continuation of the Rel-17 effort to limit power consumption.</p>
<p>15 – Ericsson LM</p> <p>We are OK to study this</p>
<p>16 – Sony Corporation</p> <p>This is a priority for IoT-NTN.</p> <p>We should scope the areas for power reduction. In IDLE mode, the UE should not be required to perform a GNSS measurement just a PO / DRX cycle just in case it is scheduled with DL data. In connected mode, PDCCH monitoring should be reduced, especially during the RTT when it is unrealistic that the UE would be scheduled.</p> <p>While we are open to considering HARQ disabling, it is questionable whether disabling HARQ reduces power consumption or increases power consumption.</p>

Feedback Form 23: Introduction of new bands in release-independent manner

<p>1 – Qualcomm Incorporated</p> <p>We do not see the need to explicitly agree on this, a RAN4 basket work item can be used for this purpose (as done with other features).</p>
<p>2 – ZTE Corporation</p> <p>Same as the reply for NR, it's mainly RAN4 topic and can be discussed following the same procedure.</p>
<p>3 – Gatehouse Satcom A/S</p> <p>Since new bands introductions are very depended on (local) governmental regulations, or spectrum licenses, and at the same time need to be technically feasibility in relation to link-budget and co-existence, it is important to plan the introduction within RAN4 as release-independent.</p>
<p>4 – Apple Benelux B.V.</p> <p>Support to having to introduce new bands in a release independent manner.</p>
<p>5 – Beijing Xiaomi Mobile Software</p> <p>At this stage we think it may be a RAN4-dedicated topic, not sure if it should be discussed here.</p>
<p>6 – THALES</p> <p><u>Justification (commercial needs)</u></p>

Allow to develop UE devices that can, operate in bands allocated to mobile satellite services satellites and hence increase the market size of IoT-NTN.

For example, L-band, XL-band as well as combination of S&L band.

Objective

Note: Leverage S band framework defined as part of Rel-17 NR-NTN-solutions WI

Adjacent channel coexistence scenarios between NTN and TN. [RAN4]

Satellite node Rx/Tx transmission specification. [RAN4]

Possible adjacent channel coexistence study with terrestrial. [RAN4]

In addition to the consideration of current MSS allocations in L and S bands, consideration should be given to the potential new allocations for narrowband MSS to be decided in WRC'23 AI 1.18 as per Resolution 248. This may represent new MSS spectrum made available explicitly for intermittent, delay-tolerant IoT NTN services. Liaison between 3GPP and ITU WP4C may be needed to ensure the spectrum is made available under a proper arrangement suitable for 3GPP IoT NTN deployment. [RAN4]

Involved WGs

Leading : RAN4

Secondary : -

Potential impact to SA/CT

None

7 – CATT

Supprt to go this way, if new band need to be introduced for IoT NTN.

8 – Guangdong OPPO Mobile Telecom.

NTN new bands can be handled in RAN4 with usual approaches like NR new bands.

9 – MediaTek Inc.

RAN4 normal practice

10 – Ericsson LM

As previously commented, we believe 3GPP should work within the allocation done by the appropriate organizations.

11 – NOVAMINT

L-band frequencies are of high interest for IoT devices as it will be a good complementary to S band and existing terrestrial bands for 3GPP IoT (800/1800) without adding complexity on the device side. It will allow to increase the market size of 3GPP IoT.

One of the objectives should be though to look into the cohabitation between Non terrestrial and terrestrial bands.

RAN 4 driven and it should be independent of the releases (as per the discussion in June for release 17).

12 – Sony Corporation

Can be considered according to the usual RAN4 procedures.

2.2 Moderator Summary and recommendation for further discussion

Many thanks for the constructive feedback in the intermediate round. The moderator summary on the topics and recommendations can be found below.

2.2.1 Evolution of NR NTN (Non-Terrestrial Networks)

1) Coverage enhancement (to address commercial smartphones and VoNR)

RAN1 (RAN2/RAN4)

Possible Impact to SA4

Companies generally viewed this item as critical for Rel-18 and to target low-rate messaging and voice support. Some companies suggested to start with Study Item. The moderator recommendation is to comment on the list of possible objectives in the final round discussion area and to consider if a study item is required prior to any work item.

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

RAN4 (RAN1)

The moderator view is that this is already confirmed to start work in RAN4 after March 2022 considering Ka band as example band once FR1 NTN coexistence study is stable enough per RAN#92-e agreement in RP-211596. The moderator recommendation is to comment on the list of possible objectives in the final round discussion area.

3) NTN-TN and NTN-NTN mobility and service continuity enhancements

RAN2 (RAN1(?), RAN4)

Possible SA/CT impact for Mobility and session management

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. The moderator recommendation is to comment on the list of possible enhancements in the final round discussion area including the topic of multi-connectivity for NTN.

4) NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation

There were mixed views on the urgency of this topic. Many companies would prefer to focus Rel-18 work on essential functionality, performance enhancements, service continuity, and reliability first. Given the strong need expressed for service continuity and reliability in Rel-18, the moderator recommendation is to add the topic of multi-connectivity for NTN to the list of possible objectives in the mobility enhancements topic.

5) Support of MBS

If necessary, RAN2 (RAN1, RAN3)

The moderator sees interest level for support of MBS focused on public safety needs, software upgrades and multimedia content. The moderator recommendation is to consider the combined feature set of Rel-17 NTN and Rel-17 MBS as the baseline for MBS support in Rel-18. Companies are encouraged to perform a gap analysis and evaluate any need to resolve any critical issues for MBS support in NTN that may not be solved by the combined feature set of Rel-17 NTN and Rel-17 MBS.

6) Network based UE location

RAN1 (RAN2/RAN3/RAN4)

Many companies highlighted the need to fulfil regulatory requirements for regulated services (e.g. lawful intercept, emergency communications, public warning service) as well as handling of requirements where law enforcement apply that the network shall be able to provide a “reliable” UE location (either network verified or network provided).

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 would be needed to clarify the scope and to consider leveraging existing positioning solutions. Some views were expressed to consider handling the work in Rel-18 Positioning Enhancements to involve positioning experts.

7) Power reduction for NTN devices

Based on company views, the moderator recommendation is to leverage existing NR power reduction features as well as any Rel-18 objectives in other topics that reduce power consumption. There seems to be no need for a specific NTN Rel-18 WI.

8) Regenerative Payload with Inter-Satellite Link (ISL)

RAN2/RAN3

Based on the intermediate round input, further discussion is needed to understand which architecture option should be prioritised for the commercial needs. The moderator recommendation is to propose a Rel-18 study item to down-select to one architecture for regenerative payload from TR 38.821 among gNB, gNB-DU, and IAB-like sat and consider follow-on WI objectives based on selected architecture.

There were views to separate the ISL discussion from Regenerative Payload. The moderator recommendation on ISL is to consider the scope and impact for 3GPP first and encourages company views on the ISL topic in the final round.

9) Enhanced beam management

RAN1 (RAN2)

The moderator recommendation is to leverage beam management enhancements from Rel-17 WI and to consider Rel-17 leftovers in Rel-18. Consideration of a specific NTN WI for this topic should be based on a gap analysis if NR beam management cannot support the NTN use case. Companies are encouraged to perform a gap analysis and evaluate any need to resolve any critical issues for Enhance beam management support in NTN that may not be solved by NR beam management.

10) Introduction of new bands in release-independent manner

The moderator recommendation is to follow normal RAN4 spectrum-related WI process for introduction of new bands.

11) Study of DL PAPR reduction (new waveforms should not be considered in Rel-18)

RAN1 (RAN2/RAN4)

The majority of the companies expressed concern with specifying new waveforms in the downlink due to impact on Rel-17 devices and backwards compatibility. The moderator recommendation is to focus on implementation-specific solutions based on Rel-16 SI outcome given the impact of new waveforms on RAN1 workload (as well as downstream impact on RAN2/RAN4), specification impact, and impact to Rel-17 devices.¹

12) Study of UE without GNSS

RAN1 (RAN2/RAN3/RAN4)

Possible SA/CT impact for PLMN and core network selection/registration and LCS

Company views vary on this topic including the justification based on cost/complexity and power consumption reduction. GNSS availability is also a concern which could limit existing Rel-17 solution. Any discussion on the priority level in relation to other Rel-18 items to be discussed later given that there was not consensus on the need.

The moderator recommendation is to consider a study item in Rel-18 and to comment on the list of possible objectives in the final round discussion area.

13) Others:

Some concerns raised on the reflector and in the intermediate round feedback forms concerning the lack of spectrum reuse/sharing and HD-FDD based on RedCap while avoiding BW/antenna restrictions were not included in the intermediate round for further consideration.

The moderator proposes that the 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.

The moderator assumed that any RedCap extensions to NTN could be handled on a case-by-case basis since it would be leveraging existing capability. Companies are welcome to share their views in the final round on this topic.

2.2.2 Evolution of IoT (Internet of Things) NTN

1) Limited IoT-NTN scope in Rel-18 (focus primarily on remaining issues from Rel-17 and incorporating relevant enhancements from Rel-17 NR-NTN)

RAN2 (RAN1/RAN4)

There was general alignment to focus on small enhancements based on existing features and to further discuss the details of the functionality that was not part of Rel-17 IoT NTN WI. The moderator recommendation is to

comment on the list of possible objectives in the final round discussion area.

2) Mobility enhancements

RAN2 (RAN1/RAN3/RAN4)

SA/CT impact for mobility/session mobility

The moderator recommends to further discuss the objectives in the final round based on the principle of small incremental enhancements to existing IoT features.

3) Further enhancement to discontinuous coverage

RAN2 (RAN1/RAN3)

SA/CT impact to study the enhancement for discontinuous coverage in SA2 and CT1

General agreement to handle discontinuous coverage in Rel-18 due to limiting functionality in Rel-17 to avoid core network impact while considering the Rel-17 outcome. Additional views expressed to treat together with store-and-forward on-board NTN payload topic. The moderator recommendation is to merge support for store-and-forward on-board NTN payload if Regenerative Payload work is part of Rel-18 and to comment on the proposed list of objectives in the final round.⁴

4) Support for store-and-forward on-board NTN payload

RAN2 (RAN1/RAN3)

SA/CT impacts for support of regenerative payload

The moderator recommendation is to merge this topic with Further enhancement to discontinuous coverage if Regenerative Payload work is part of Rel-18 and to consider the list of possible objectives in the final round.

5) Preconfigured Uplink Resource

The moderator recommendation is to merge this topic with Further enhancement to discontinuous coverage as part of Rel-18. The PUR objective as an option has been included in the moderator views on that topic.

6) Power reduction for IoT NTN devices

Power reduction for IoT NTN devices is seen as an important and necessary. The moderator's view from the company input is that the power reduction ideas are covered in the proposed objectives in the other topics. The moderator recommendation is to handle in the SI/WIs for the specific areas identified as opposed to a separate WI.

7) Introduction of new bands in release-independent manner

Moderator recommendation is to follow normal RAN4 spectrum-related WI process for introduction of new bands.

3 Final Round

3.1 Collection of company views

In all cases, please provide your feedback on the proposed lead WG and supporting WGs as well as SA/CT impact as proposed in the moderator summary.

3.1.1 Evolution of NR NTN (Non-Terrestrial Networks)

1) Coverage enhancement (to address commercial smartphones and VoNR)

Please provide your views on the following objectives.

- Adapt the work from the general NR coverage enhancement WID and limit work to specific gaps for NTN
- Downlink and uplink enhancements (possible items below):
 - repetitions and diversity techniques for the relevant channels (including PRACH)
 - CSI aging mitigation
 - DM-RS config
 - Improve the performance of low-rate codecs in link budget limited situation (SA4 impact?)
 - Investigate means to mitigate packet interruption due to low UL SNR and beam/cell switching for NTN

Feedback Form 24: Coverage enhancement (to address commercial smartphones and VoNR)

<p>1 – Lockheed Martin</p> <p>Lockheed Martin agrees with the above listed objectives for coverage enhancement addressing commercial smartphones and VoNR.</p>
<p>2 – Nokia France</p> <p>We do not see that specific gaps have been identified for NTN. The possible enhancements suggested here overlap with general coverage enhancement topics and should be treated there in order to avoid divergence of solutions.</p>
<p>3 – Apple Poland Sp. z.o.o.</p> <p>We support this objective. Coverage enhancement is essential for smartphones which has low antenna gain. However, we do not think there is a need to emphasize “to address commercial smartphones and VoNR” in the title. We are not sure about why only UL SNR (i.e., not both DL SNR and UL SNR) is mentioned in the last bullet?</p>
<p>4 – ZTE Corporation</p> <p>We support this proposal along with the 2nd level details. In our view, improvement on the performance for both smart phone and other UE types can be covered by using more general title, e.g., performance</p>

improvement for both DL and UL
<p>5 – Asia Pacific Telecom co. Ltd</p> <p>We support this objective. thanks.</p>
<p>6 – Beijing Xiaomi Mobile Software</p> <p>We are supportive to moderator’s recommendations to have a study phase before the nominate work. However, the potential solutions may be further discussed. We can have a more generic description at the current stage rather than listing the candidate solutions.</p>
<p>7 – Lenovo (Beijing) Ltd</p> <p>We agree this issue should be addressed in R18. Regarding the detailed objectives, our view is that we should avoid duplication work between R18 NTN and coverage enhancement WI. We should identify NTN specific issues. Maybe we should first study the limiting channel and NTN scenario specific characteristics.</p>
<p>8 – Samsung Electronics Co.</p> <p>We agree that coverage enhancement is one of the important aspects for NTN. But we believe this is not only for NTN but also for other use cases. So, this can be worked in other WI (e.g., further enhancement of coverage).</p>
<p>9 – Guangdong OPPO Mobile Telecom.</p> <p>We are in general fine with lists for coverage enhancement and prefer not to exclude other potential techniques (if any).</p>
<p>10 – Spreadtrum Communications</p> <p>We support this objective for coverage enhancement. But, it is not necessary to list potential solutions now.</p>
<p>11 – Qualcomm Incorporated</p> <p>We would like to emphasize once again that this is the most critical item for Rel-18 NTN, focusing on both low-rate data (e.g. messaging) and low-rate voice. As a couple of comments: 1) We would like to add “techniques to enable full-power UL transmission and reduced polarization loss” to “repetitions and diversity techniques”. In the “improve the performance of low-rate codecs in link budget limited situation”, we may add “including reducing RAN protocol overhead”. Other than that it looks good. On the impact to SA4, we think the initial work in RAN1/2 would be to take current SA4 specifications as a baseline, and liaise as needed.</p>
<p>12 – DOCOMO Communications Lab.</p> <p>As commented in intermediate round, this topic (if really needed and supported) should be started from study item. Without sufficient identification of which channel/signal is not enough, why we can decide to start work item for this purpose?</p>
<p>13 – vivo Mobile Communication Co.</p> <p>For the detailed coverage enhancement areas, it seems some enhancement areas are not coverage-related (e.g., CSI aging mitigation), while others are not NTN specific (e.g., repetitions and diversity techniques). We prefer to study and identify NTN specific coverage issues firstly, then focus on the most necessary enhancement areas.</p>

<p>14 – THALES</p> <p>Agree with Moderator proposed way forward</p>
<p>15 – Intelsat</p> <p>Agree with the proposed way forward, but see this as less urgent than other topics.</p>
<p>16 – VODAFONE Group Plc</p> <p>We also agree with moderator’s suggestion to have a Study Phase</p>
<p>17 – Intel Corporation SAS</p> <p>In general, the objectives look fine to us except “CSI aging mitigation”. In Rel-16 NR NTN SI this issue was studied and based on this study it is not clear if spec enhancements are needed.</p> <p>Also, before normative work we prefer some study phase to understand whether enhancements are needed and identify solutions.</p> <p>Regarding SA4 impact for low-rate codecs performance enhancements, a note can be added to this objective indicating that SA2/SA4 WGs could be added in the discussion in need basis via LSs.</p>
<p>18 – CATT</p> <p>We support this objective, and we share the view with ZTE that we can use a more general title, e.g., performance improvment for both DL and UL.</p>
<p>19 – InterDigital</p> <p>Support the proposed objectives and lead/support WGs</p>
<p>20 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <ul style="list-style-type: none"> - The list of possible enhancements are not in the same level of details and some bullets are not relevant to coverage, e.g. CSI aging was studied in Rel-16 SI and it was concluded that this can be mitigated by gNB implementation. For “means to mitigate packet interruption”, it is not clear what packet interruption is from physical layer point of view. - There is no need to have a separate SI and a study phase can be within the potential WI.
<p>21 – TURKCELL</p> <p>We think that coverage enhancement is critical for Rel-18 and to target low-rate messaging and voice support. We agree with moderator to have a study item.</p>
<p>22 – Ericsson LM</p> <p>In general we would like to anchor this objective in the Coverage Enhancement WID, as no specific gaps have been identified for NTN so far.</p>
<p>23 – Fraunhofer IIS</p> <p>We agree with moderators approach</p>

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

Please provide your views on the following objectives.

- Study and identify NTN bands: Analysis of regulations and adjacent channel co-existence and protection of TN
- Specify Rx/Tx requirements for different VSAT/ESIM UE class (not only 60 cm aperture)
- Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed.
- Specify the conformance testing
- Specify the RRM requirements
- Physical layer parameters such as SCS for SSB, data channels
- Beam management in FDD (the current beam management schemes in FR2 assumes TDD)
- Beam management in NTN considering the characteristic of satellite beams (e.g. large beam foot

print size)

Feedback Form 25: NR-NTN deployment in above 10 GHz bands and support for VSAT/ESIM NTN UE

<p>1 – Nokia France</p> <p>Bands above 10GHz can be considered, but note that first the issues of general operation of FDD in FR2 and the handling of 7-24GHz bands would need to be handled and concluded.</p>
<p>2 – Apple Poland Sp. z.o.o.</p> <p>Agree with Nokia that we first need to address the general issues of TDD bands for satellite communication or FDD over FR2 need to be addressed.</p>
<p>3 – ZTE Corporation</p> <p>Regarding the frequency band along with corresponding work in RAN4, we are open to discuss it and main decision can be up to RAN4. But if such band is supported, for the technical aspect, we need to study the general issue, especially if TDD is considered for satellite (corresponding study may also be applicable for the HAPS based TDD). For FDD, the potential issues will be limited. As editorial changes, we prefer to merge the last two bullets since all of them are for beam management.</p>
<p>4 – Lenovo (Beijing) Ltd</p> <p>We are generally fine with deployment above 10GHz. Regarding SCS for SSB and data channel, our view is that we should reuse features in NR R15/R16 and 52.6GHz in R17 to leveraging the existing SCS. Regarding beam management for satellite beams, our preference is to take R17 discussions as a starting point. If above 10GHz band is determined to be a FDD band, we are fine to study the beam management related issues.</p>
<p>5 – Samsung Electronics Co.</p> <p>We are fine with Moderator’s proposals.</p>

<p>6 – Guangdong OPPO Mobile Telecom.</p> <p>We agree with moderator’s view.</p>
<p>7 – Qualcomm Incorporated</p> <p>We are OK with the first 6 items. The last two items, in our view, are mainly RAN1/RAN2 issues and have been discussed in Rel-17 to a certain degree. We can merge the last two as “ 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).</p>
<p>8 – THALES</p> <p>=Thales> Agree with Moderator’s way forward.</p>
<p>9 – MediaTek Inc.</p> <p>OK</p>
<p>10 – Intelsat</p> <p>Agree with the proposed way forward. The first two bullets 1) Study and identify NTN bands, 2) Rx/Tx requirements for different VSAT/ESIM UE classes are more important for us.</p>
<p>11 – VODAFONE Group Plc</p> <p>Considering the Time and Resources required for this Study, it will be useful to have features for VSAT applications.</p>
<p>12 – Intel Corporation SAS</p> <p>It is not clear for us why objectives related to beam management should be considered, especially if RAN1 is involved. At the Rel-16 NR NTN SI beam management was also considered and there were no significant issues identified, except some enhancements for beam management and BWP operation for scenarios with frequency reuse.</p>
<p>13 – CATT</p> <p>We are fine with Moderator’s proposal.</p>
<p>14 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>1 We are fine to studies these aspects. As commented earlier, some work should be done in RAN4, while some others should be done in RAN1.</p>
<p>15 – TURKCELL</p> <p>We agree with Moderator’s proposal</p>
<p>16 – Spreadtrum Communications</p> <p>We are fine with Moderator’s proposal.</p>

17 – Panasonic Corporation

We support the objectives summarized by moderator.

18 – Ericsson LM

We would suggest to reword this as ”Study and identify NTN bands: Analysis of regulations and adjacent channel co-existence for future proof protection of TN”

19 – Fraunhofer IIS

Fraunhofer agrees and contributes in the preparation of this study item, which is lead by Inmarsat.

3) NTN-TN and NTN-NTN mobility and service continuity enhancements

Please provide your views on the following enhancements:

- Address handover interruption, handover signalling overhead and RACH congestion
- Address RLF reduction issue for different delay and/or network topology between the different access types/points/nodes
- NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements
- Multi-connectivity for NTN

Feedback Form 26: NTN-TN and NTN-NTN mobility and service continuity enhancements

1 – Apple Poland Sp. z.o.o.

We support this objective. However, from our view there may be some RAN1 impact as well.

2 – ZTE Corporation

In general, we are fine to further improve the mobility and service continuity. But it seems that multiple bullets are included. It’s preferred to define the priority order to manage the workload across WGs. For example, the 3rd bullet ”measurement/mobility and service continuity enhancements” is too general. Moreover, it’s not sure whether we need to conduct the all works including improving the legacy behavior and defining a new feature as ”Multi-connectivity” in one release for the same purpose.

3 – China Mobile Group Device Co.

The proposed enhancements are ok to us.

4 – Asia Pacific Telecom co. Ltd

The proposals are OK. However, should we further indicate the handover types (e.g., conventional handover, CHO, DAPS handover) in this topic ?

5 – Beijing Xiaomi Mobile Software

We are fine with this.

6 – Lenovo (Beijing) Ltd

We think service continuity is a critical issue to be addressed in NR NTN, and we prefer asynchronous multi-connectivity to address it.

7 – Samsung Electronics Co.

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

8 – Guangdong OPPO Mobile Telecom.

Regarding the first three bullets, we think the detailed objectives depend on Rel-17's outcome. Regarding the last bullet, although we wonder whether it should be decoupled from mobility, we are fine to include it.

9 – Spreadtrum Communications

We are fine to discuss this topic in R18.

10 – Qualcomm Incorporated

We agree with moderator recommendation that all of the above should use existing methods from NR TN as baseline. However, we are concerned with the expansive list which makes it look like a huge amount of time is to be allocated for the mobility enhancements for NTN. Further, multi-connectivity is again discussed in #4 below and we think that should be lower priority. Therefore, we do not see a need to explicitly list them as objectives but may be ok to capture something like "Existing mobility methods from TN are applicable and baseline for NTN. Minor adjustments are not precluded."

11 – CATT

Generally, we are fine to further improve the performance for mobility and service continuity. But it seems too many enhancements are proposed for this objective, we should further narrow down the scope for mobility enhancements.

12 – vivo Mobile Communication Co.

For the enhancement areas for NTN-TN and NTN-mobility and service continuity, we don't see the necessity to include the last bullet multi-connectivity for NTN, since it is multi-connectivity related.

13 – THALES

Agree with Moderator's way forward.

14 – VODAFONE Group Plc

TN-NTN mobility and handover should be the baseline, the NTN-NTN could be de-prioritised as this could be left to Satellite Service provide

15 – Intelsat

We agree with the proposed way forward.

16 – Nokia France

This objective should be clearly stated to be applicable to IDLE/INACTIVE mode mobility/reselection enhancements as well as connected mode. It should also be stated that solutions here should minimise power consumption.

The "RLF reduction issue" would benefit from further clarification.

We support including "NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements".

Multi-connectivity for NTN should be lower priority.

17 – LG Electronics France

We are generally fine with the proposals, but we think the third and fourth issue should be prioritized:

- NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements
- Multi-connectivity for NTN

18 – Intel Corporation SAS

We are open to consider the listed enhancements. The exact scope may need to be updated based on Rel-17 NTN related work.

19 – InterDigital

Support the proposed objectives and lead/support WGs

20 – HUAWEI TECHNOLOGIES Co. Ltd.

Mobility and service continuity can be studied as second priority. We don't think multi-connectivity for NTN should be listed here since there is a separate objective below.

21 – TURKCELL

We agree with Moderator way forward. We think service continuity between NTN and TN is a critical issue to be addressed in NR NTN.

22 – Sony Corporation

We think that this should be amongst the first priority items. On the moderator's recommendation to adopt methods from NR TN as baseline, we caution that NR TN methods depend too much on measurements/reporting and so may not be wholly suitable for NTN due to long RTT.

23 – Ericsson LM

Ok to study, even though no compelling feature for TN-NTN mobility was found. Multiconnectivity is premature, should be dealt with in TN first. We don't see any deficiency in current solutions.

24 – Fraunhofer IIS

We partly agree with moderators approach. "Multi-connectivity for NTN" should be located at the topic 4 and not at topic 3

Provide comments concerning the moderator way forward on support of NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation.

Feedback Form 27: NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation

<p>1 – Apple Poland Sp. z.o.o.</p> <p>We prefer moving this item out to a future release given there are more higher priority items which need more immediate attention.</p>
<p>2 – ZTE Corporation</p> <p>We are open to discuss this feature with limited scenario since it can improve the performance from perspective of handover and throughput. According to current proposal, it can be considered as the 2nd priority for mobility.</p>
<p>3 – Lenovo (Beijing) Ltd</p> <p>We think the multi-connectivity part can be handled together with mobility and service continuity. We think multi-connectivity between different satellites can be considered, and CA for a same satellite can also be considered.</p>
<p>4 – Samsung Electronics Co.</p> <p>We agree with Moderator’s WF to study this issue in Rel-18.</p>
<p>5 – Beijing Xiaomi Mobile Software</p> <p>The multi-connections operation can not only improve the mobility enhancement, but also other aspects such as UE’s data rate. We support to have a separate topic to discuss this.</p>
<p>6 – Guangdong OPPO Mobile Telecom.</p> <p>As commented before, we think CA/DC is beneficial to improve UE’s data rate and should be included in the Rel-18 NTN.</p>
<p>7 – Qualcomm Incorporated</p> <p>In our view, this item is of lower priority, although if the TU budget allows for it we would be open to it.</p>
<p>8 – vivo Mobile Communication Co.</p> <p>For the enhancement of NTN-NTN asynchronous multi-connectivity and CA, we would like to consider also NTN-TN DC case. In addition, for CA (if supported) we would like to prioritize the intra-gNB CA on the same satellite (which is more likely a synchronous CA case to be supported). For asynchronous CA, we share the previous comments from some companies that the level of asynchronization, as well as the corresponding scenarios (e.g. CA over satellites on the same or different orbits), should first be justified.</p>

<p>9 – THALES</p> <p>Multi connectivity is a very important scheme to be addressed. It was already addressed in the Rel-16 study item but deprioritized from Rel-17. So it needs to be addressed as part of Rel-18.</p> <p>Targeted scenarios are NTN-NTN related: GEO/LEO and LEO/LEO. We are fine to have this addressed as part of the “NTN-TN and NTN-NTN mobility and service » topic</p>
<p>10 – MediaTek Inc.</p> <p>Lower priority item. If moving forward, discrepancies between constellations will need to be accounted for (e.g. delay discrepancies) or scenarios restricted e.g. same constellation type</p>
<p>11 – VODAFONE Group Plc</p> <p>This could be left as lower priority</p>
<p>12 – LG Electronics France</p> <p>As we commented in the second round, multi connectivity is very important issue to increase the data throughput and guarantee the service stability.</p>
<p>13 – Nokia France</p> <p>These aspects can be lower priority if the multi-connectivity is included in the previous bullet.</p>
<p>14 – Intelsat</p> <p>We agree with the proposed way forward.</p>
<p>15 – Intel Corporation SAS</p> <p>In general, the proposal looks interesting and can provide significant performance improvement as well as continuity of the service. However, similar to some other companies, we don't see urgent need to specify it in Rel-18.</p>
<p>16 – CATT</p> <p>We agree with Moderator's WF on this objective.</p>
<p>17 – InterDigital</p> <p>Support moderator way forward</p>
<p>18 – TURKCELL</p> <p>NTN-NTN asynchronous multi-connectivity & CA can be de-prioritized.</p>
<p>19 – Sony Corporation</p> <p>We agree with the moderator to add it to the list of possible enhancements and not the essential ones for Rel-18.</p>
<p>20 – Ericsson LM</p> <p>This is premature.</p>

21 – Fraunhofer IIS

Multi-connectivity for NTN” should be located at topic 4.

5) Support of MBS

Provide comments concerning the moderator way forward on support of MBS.

Feedback Form 28: Support of MBS

1 – Apple Poland Sp. z.o.o.

We support this objective if it turns out to have market demand.

2 – ZTE Corporation

It’s premature to take this feature for NTN in Rel-18 since no clear has been identified on the applicability of legacy design. We need to focus on the essential feature firstly.

3 – Asia Pacific Telecom co. Ltd

We support the objective.

4 – Lenovo (Beijing) Ltd

We are fine to first study the gap between R18 MBS.

5 – Samsung Electronics Co.

We don’t think this is needed for Rel-18. We believe enhancement of MBS can be done in the other WI dedicated for MBS in Rel-18.

6 – Beijing Xiaomi Mobile Software

Agree with moderator’s analysis, the potential enhancements need to be clarified based on the existing designs.

7 – Guangdong OPPO Mobile Telecom.

We are fine to revisit if there are potential issues after the discussion of combined feature set of Rel-17 NTN and Rel-17 MBS. For now, we think at least some HARQ related issues may be enhanced.

8 – Qualcomm Incorporated

Agree with moderator’s way forward

9 – CATT

As there’re too many things to do in Rel-18, this could be 2nd priority, or continue in the future release.

10 – DOCOMO Communications Lab.

Agree with moderator’s view. Further gap analysis and evaluation are needed.

<p>11 – Eutelsat S.A.</p> <p>No clear requirement for a new MBS service over NR-NTN. Commercial requirements and potential market should be studied and assessed. However, it could be a useful feature for public safety applications.</p>
<p>12 – THALES</p> <p>Agree with Moderator’s way forward. The support of MBS in NTN requires the following enhancements:</p> <ul style="list-style-type: none"> - Multicast accommodating extra delay (including HARQ deactivation). [RAN2] - Broadcasting Service continuity issues in NGSO when targeting a specific geographical area. [RAN2] - Support Mobile-Originated and Network-Originated multicast and related mobility aspects in NGSO taking into account beam topology. [RAN2]
<p>13 – MediaTek Inc.</p> <p>OK with moderator proposal</p>
<p>14 – Nokia France</p> <p>We do not see this needing NTN-specific work in Rel-18.</p>
<p>15 – LG Electronics France</p> <p>We already have many issues to treat in R18, so this issue should be discussed in the later release.</p>
<p>16 – Intelsat</p> <p>We see this as lower priority relative to other topics.</p>
<p>17 – Intel Corporation SAS</p> <p>In our view there is no urgency to specify MBS NTN, it can be considered in future releases after Rel-18.</p>
<p>18 – InterDigital</p> <p>Support moderator way forward</p>
<p>19 – Ericsson LM</p> <p>We agree that it’s a bit premature. we still don’t have a stable MBS for terrestrial in Rel-17, so it’s a challenge to envisage what it may look like in Rel-18 for NTN. At most, this should be low priority.</p>
<p>20 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We support the moderator’s way forward that a gap analysis should be done first.</p>
<p>21 – TURKCELL</p> <p>We think that MBS has lower priority relative to other items.</p>

22 – Sony Corporation

We share the view from the moderator that Rel-17 NTN and Rel-17 MBS should be the baseline. We think service continuity aspects between NTN and TN for MBS service should be studied further.

23 – Spreadtrum Communications

We are fine with the way forward.

24 – Fraunhofer IIS

For receive-only Broadcast w/o return link, we do not see any standardization impact, which should be confirmed within a small study.

For Multicast, higher latency over satellite might have few impact in protocols (RAN2).

6) Network based UE location

Provide comments concerning the moderator way forward on Network-based UE location.

Feedback Form 29: Network based UE location**1 – Apple Poland Sp. z.o.o.**

We think this objective is a complementary solution to item 12. Overall, we prefer to deprioritize the study of network based UE location.

2 – ZTE Corporation

We are open to this topic, but prefer to take it as the 2nd priority.

3 – China Mobile Group Device Co.

Anyway, UE location acquisition solutions for NTN scenarios are demanded to study. Whether it is in the R18 NTN scope or under R18 positioning is acceptable.

4 – Beijing Xiaomi Mobile Software

We are supportive to this topic and this should be within the potential NTN WI rather than the positioning WI.

5 – Asia Pacific Telecom co. Ltd

We are OK to this objective.

6 – Lenovo (Beijing) Ltd

We think position is an import feature in NR NTN considering various use cases. And we prefer this is treated in NTN WI rather than positioning WI.

7 – Samsung Electronics Co.

We don't see a strong motivation for this in NTN. We prefer to take it as the 2nd priority.

<p>8 – Guangdong OPPO Mobile Telecom.</p> <p>We think whether enhancement is needed or not for network based UE location depends on Rel-17's outcome.</p>
<p>9 – Qualcomm Incorporated</p> <p>We would be OK with considering this, but as the moderator also indicated, the scope has to be clarified.</p>
<p>10 – CATT</p> <p>We agree that a study phase is needed for network based UE location.</p>
<p>11 – DOCOMO Communications Lab.</p> <p>As commented before, this item should be handled by positioning experts as sidelink situation.</p>
<p>12 – THALES</p> <p>Agree with Moderator's way forward to start a study on this utmost important feature for the deployment/operation of NTN.</p> <p>The topic has started to be discussed as part of Rel-17 NR-NTN-solutions in (R2-2101150 Summary of [Post112-e][115][NTN] the Email Discussion on LCS for NTN Fraunhofer IIS, Fraunhofer HHI)</p> <p>Thales recommends</p> <ul style="list-style-type: none"> - to prioritize a "network verify" solution that doesn't require high accuracy in UE location determination - to leverage existing RAT dependent techniques (e.g. multi RTT) to accommodate varying and larger delay.
<p>13 – MediaTek Inc.</p> <p>Scope needs clarification</p>
<p>14 – VODAFONE Group Plc</p> <p>Necessary feature for Rel17 and Rel18 , we agree</p>
<p>15 – LG Electronics France</p> <p>We can treat the leftover issues from R17 NR NTN.</p>
<p>16 – Nokia France</p> <p>We support the moderator's WF.</p>
<p>17 – Intelsat</p> <p>We support the proposed way forward.</p>

<p>18 – Intel Corporation SAS</p> <p>This item has low priority from our perspective. We don't see urgent need to specify network-based positioning for NTN in Rel-18, especially considering potentially big scope for positioning in Rel-18.</p>
<p>19 – InterDigital</p> <p>Support a study Item on this topic and proposed lead/support WGs</p>
<p>20 – Ericsson LM</p> <p>Should be low priority; in any case, it should be handled as part of positioning. Also, in our understanding all regulatory requirements (lawful intercept, emergency calls, etc.) can be met already with the Rel-17 solutions (at least to the same degree as in terrestrial networks).</p>
<p>21 – CEWIT</p> <p>We agree to study network based UE location.</p>
<p>22 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>1 It is better to confirm whether the target is to fulfill the regulatory requirements for regulated services not to support UEs without GNSS. We see a fundamental difference here since it is impossible to provide UE location information before get access to the network.</p>
<p>23 – TURKCELL</p> <p>We support Moderator's proposal.</p>
<p>24 – Panasonic Corporation</p> <p>We support the moderator way forward to start SI.</p>
<p>25 – Fraunhofer IIS</p> <p>We agree with moderator to start a Rel-18 study on Network based UE location. We support handling this topic within Rel-18 Positioning enhancements to avoid overlap of standardization work in NTN and positioning work items, as happen several times during Rel-17.</p>

Provide your views if NTN Network-based UE location should be merged into Rel-18 Positioning Enhancements.

Feedback Form 30: Merging into Rel-18 Positioning Enhancements

<p>1 – Apple Poland Sp. z.o.o.</p> <p>Agree with moderator views and believe that discussions on this topic need to happen in R18 positioning enhancements.</p>
<p>2 – ZTE Corporation</p> <p>It may not be proper to merge this into Rel-18 positioning since the existing scope for positioning is already large. Meanwhile, due to the significant difference on the scenario, the higher-level discussion on this topic</p>

including requirement and target (e.g., accurate or just to serve the UE without GNSS) should be considered firstly.

3 – Beijing Xiaomi Mobile Software

We don't support to have this in positioning enhancement as the network based positioning for NTN may differ in many aspects such as requirements/potential solutions compared to the one in TN system.

4 – Lenovo (Beijing) Ltd

We prefer this is handled in NTN rather than in positioning enhancement.

5 – Samsung Electronics Co.

It can be done in the discussion of Rel-18 positioning SI/WI.

6 – Guangdong OPPO Mobile Telecom.

We think NTN positioning may either be merged into Rel-18 positioning enhancements, or be discussed with non-GNSS UE together.

7 – Qualcomm Incorporated

Depending on the specific scope of the item, we can list it under positioning or NTN (needs further discussion)

8 – CATT

As we never mentioned the NTN enhancements in the scope of "Positioning Enhancements", maybe it's not easy to re-scope that WI for NTN.

We understand the potential way is to keep the "Network based UE location" and "Study of UE without GNSS" as the objectives of NR NTN evolution. We can further study the use cases and solutions in the **study phase** of NR NTN Rel-18 WI.

Anyway, we are open to discuss.

9 – DOCOMO Communications Lab.

As commented before, this item should be handled by positioning experts as sidelink situation. "Already large scope of current positioning" should not be a reason to handle here. If the topic is really needed, positioning experts can decide this as higher priority there.

10 – THALES

We would have some preference to have it handled as part of a NTN related WI given the specifics of NTN systems. But if other prefer to have it addressed as part of a positioning item, this can be acceptable as long as it is addressed in Rel-18

11 – MediaTek Inc.

Unclear at this moment until the scope is clarified

<p>12 – Nokia France</p> <p>The home for this work is probably a matter for later discussion. Both options (NTN or positioning WIs) would be workable.</p>
<p>13 – Intelsat</p> <p>Seems it could be handled as part of the Rel-18 positioning topic.</p>
<p>14 – InterDigital</p> <p>Our preference would be to have a study item</p>
<p>15 – Ericsson LM</p> <p>We agree it should be handled as part of positioning.</p>
<p>16 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Clearly a comprehensive study is needed with the involvement of positioning experts. We see difficulties to add more workload for positioning in Rel-18.</p>
<p>17 – TURKCELL</p> <p>It can be under Rel-18 positioning SI/WI.</p>

7) Power reduction for NTN devices

Provide comments concerning the moderator way forward on Power reduction for NTN devices.

Feedback Form 31: Power reduction for NTN devices

<p>1 – Apple Poland Sp. z.o.o.</p> <p>Agree with moderator recommendation for now. However, any additional enhancements that can save UE power should not be precluded at this time.</p>
<p>2 – ZTE Corporation</p> <p>We are supportive to moderator’s recommendation.</p>
<p>3 – Lenovo (Beijing) Ltd</p> <p>Our view is that this can be treated in other WI.</p>
<p>4 – Samsung Electronics Co.</p> <p>We agree with Moderator’s WF not to include this, unless there is a specific necessity due to NTN channel characteristics. If needed, that can be done in the SI/WI for power saving enhancement.</p>
<p>5 – Beijing Xiaomi Mobile Software</p> <p>We support moderator’s view. This apply to limited scenario, and thus could be the deprioritized.</p>

<p>6 – Guangdong OPPO Mobile Telecom.</p> <p>Power consumption is very important for terminal devices. We support this objective.</p>
<p>7 – Qualcomm Incorporated</p> <p>Agree with moderator’s recommendation</p>
<p>8 – CATT</p> <p>Agree with the moderator’s recommendation.</p>
<p>9 – vivo Mobile Communication Co.</p> <p>For power reduction for NTN devices, we support to study and identify the potential enhancement areas for NTN specific cases, the specified power saving schemes in Rel-16/17 could be reused as a starting point.</p>
<p>10 – DOCOMO Communications Lab.</p> <p>Support moderator’s view.</p>
<p>11 – THALES</p> <p>Agree with Moderator’s way forward</p>
<p>12 – MediaTek Inc.</p> <p>OK with moderator proposal</p>
<p>13 – VODAFONE Group Plc</p> <p>Can be handled elsewhere not under NTN</p>
<p>14 – Nokia France</p> <p>We support the moderator’s WF.</p>
<p>15 – Intelsat</p> <p>We agree with the proposed way forward.</p>
<p>16 – InterDigital</p> <p>Support moderator way forward</p>
<p>17 – Ericsson LM</p> <p>We agree with the moderator.</p>
<p>18 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Agree with the proposed ward forward</p>

19 – TURKCELL

We support moderator recommendations.

20 – Fraunhofer IIS

We agree with moderators approach.

8) Regenerative Payload with Inter-Satellite Link (ISL)

Provide comments concerning the moderator way forward on Regenerative Payload.

Feedback Form 32: Regenerative Payload**1 – Lockheed Martin**

Lockheed Martin agrees with the moderator’s recommendation to propose a Rel-18 study item to down-select to one architecture for regenerative payload from TR 38.821 among gNB, gNB-DU, and IAB-like and consider follow-on WI objectives based on selected architecture.

2 – Classon Consulting

for FUTUREWEI Support

3 – Apple Poland Sp. z.o.o.

We dont completely agree to the moderator recommendations here and dont understand why existing architectures and features of CU-DU split cannot be mostly reused and dont understand the need for a down-selection or a study at this point of time.

4 – China Mobile Group Device Co.

Considering the limited time and large scope of NTN, we agree with the moderator’s suggestion to down-select one regenerative architecture to discuss firstly. However, from our perspective, a new R18 SI is not necessary, just include it in R18 NTN WI is enough.

5 – ZTE Corporation

We share the views from moderator and down-selection on architecture should be considered to ensure the manageable scope with justified gain for performance and complexity.

6 – Lenovo (Beijing) Ltd

Our view is that regenerative payload should be supported to reduce latency. And ISL should also be supported considering the deployment scenarios. We are fine to down select the architectures.

7 – Samsung Electronics Co.

We agree with Moderator’s WF to study and down-select for one architecture.

8 – Guangdong OPPO Mobile Telecom.

We agree with moderator’s view.

9 – Qualcomm Incorporated

It would be good to get a more precise scope for this item before starting any activity in 3GPP. Having a study covering all possible splits will result in a very large workload. At least from our side, we do not see any urgency of specifying this in 3GPP (implementation-based solutions should be possible without 3GPP work on these items).

10 – Eutelsat S.A.

Support R18 study (as proposed).

11 – CATT

We agree to support Regenerative architecture in Rel-18.

But it seems not necessary to start a Study Item to down-select the architecture options from TR 38.821.

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 further release.

12 – DOCOMO Communications Lab.

We agree with moderator's view. On ISL, this is the main motivation of regenerative payload in my understanding. Therefore, ISL should be a set with regenerative payload.

13 – THALES

Different options (gNB, DU or IAB node on board satellite) have been identified as part of the Rel-16 FS-NR-NTN-solutions study item. The two first have been studied (identifying potential spec impacts).

It is not clear to us, which option is preferred by the satellite stakeholders so we question about the need to do another study (expect addressing IAB node on board).

14 – MediaTek Inc.

OK with moderator proposal

15 – VODAFONE Group Plc

Regenerative architecture is useful and would reduce the round trip time , however why is this a 3GPP issue? it should be left to Satellite service provider? It is implementation architecture choice

16 – Nokia France

The moderator's proposal to start with a study of the architectural options is OK, but should be subject to there being sufficient capacity available after higher-priority topics.

17 – Intelsat

We agree with the proposed way forward.

18 – Intel Corporation SAS

As we commented in previous round, we are supportive to introduce regenerative payload in Rel-18. It should include RAN2/RAN3 scope with downselection of network architecture and corresponding enhancements to support it.

19 – InterDigital

Support a study Item to down select between possible regenerative architectures and suggested lead WGs. Our primary concern in previous rounds was the time this would take if included in NTN WI, and we think a study item first is a sensible way forward.

20 – Ericsson LM

Ericsson comment: We strongly disagree. The selection of the regenerative architecture was done in the Rel-16 SI. For the benefit of companies who did not participate in the Rel-16 study or forgot: the interface involved in the CU-DU split (F1) is not made for tearing down and setting up on the fly, as would happen with a CU on the ground and a DU on board a satellite (especially LEO). Doing so would remove all UE contexts and drop all connections. This cannot be easily addressed without modifying the NG-RAN architecture specified since Rel-15 (which is not acceptable to us). This discussion can be found in TR 38.821. For this reason, the conclusion was that the only regenerative architecture that can be used “out of the box” is the one with the full gNB on board (which also has the benefit of supporting ISL via Xn; ISL is precluded in the CU-DU split option as there cannot be any inter-DU interface without modifying the NG-RAN architecture). For this reason, Rel-18 NTN should be based on the regenerative full gNB on board option, consistently with the SI conclusions.

21 – HUAWEI TECHNOLOGIES Co. Ltd.

We support to have a work item on regenerative payload. The down-selection of network architecture options can be part of the work.

22 – TURKCELL

We agree with Qualcomm and Vodafone. This is implementation based architecture left to satellite service providers.

23 – Panasonic Corporation

We support the moderator way forward to down-select to one architecture in the beginning of Rel-18.

24 – Fraunhofer IIS

Since this topic need careful evaluation of deployment scenarios with 5G-NTN, we propose to include the related topics regenerative payloads and ISL in Rel-18 and discuss to further downscope the scenarios until December plenary.

Provide company views on ISL 3GPP impact and scope.

Feedback Form 33: Inter-Satellite Link (ISL)**1 – Classon Consulting**

for FUTUREWEI Support

<p>2 – Apple Poland Sp. z.o.o.</p> <p>agree with moderator views on ISL.</p>
<p>3 – ZTE Corporation</p> <p>Agree. We need to conclude the potential expectation on the discussion for ISL.</p>
<p>4 – Samsung Electronics Co.</p> <p>We support this issue. We think it is quite related to regenerative payload study, so this can be done with the above issue for regenerative payload.</p>
<p>5 – Guangdong OPPO Mobile Telecom.</p> <p>We agree with moderator’s view.</p>
<p>6 – Qualcomm Incorporated</p> <p>Needs to be jointly discussed with the architecture options in the previous question.</p>
<p>7 – CATT</p> <p>I tend to agree that ISL could be decoupled with regenerative architecture, as ISL could be used for transparent payload architecture and also regenerative architecture.</p> <p>If we consider supporting ISL as a kind of transport layer, how to generate and maintain the ISL are out of the scope of RAN groups. This is the most feasible way forward if we do not consider the complex architectures e.g. IAB-like architecture in Rel-18.</p> <p>However, how to adapt the change of backhaul connections should be considered, e.g. a gNB on-board changes the backhaul connection, e.g., from feeder link to a ISL provided by another satellite, the TNLA between the gNB and AMF may need to be re-established.</p>
<p>8 – DOCOMO Communications Lab.</p> <p>Agree. ISL is the main motivation of regenerative payload in my understanding. Therefore, ISL should be a set with regenerative payload.</p>
<p>9 – THALES</p> <p>Not clear what needs to be defined here. It is questionable whether 3GPP is ready to specify optical based protocols since a lot of ISL may be based on optical communication technologies.</p>
<p>10 – MediaTek Inc.</p> <p>Same view as expressed by Qualcomm</p>
<p>11 – VODAFONE Group Plc</p> <p>Not 3GPP issues, should be left to implementation and to Satellite Service providers</p>
<p>12 – Intelsat</p> <p>Seems this can be addresses as part of the regenerative topic.</p>

<p>13 – Intel Corporation SAS</p> <p>ISL can be considered as backhaul link. Enhancements can be further discussed in study phase (if needed).</p>
<p>14 – InterDigital</p> <p>Agree with Intel that ISL should be considered as backhaul, and should be considered with regenerative study</p>
<p>15 – Ericsson LM</p> <p>By selecting the full gNB on board option, support for ISL is not precluded as it is already enabled through the existing Xn specifications. It is certainly not mandatory (no feature in 3GPP is mandatory except for slicing), so implementations still have the full flexibility to use it or not. It would not be wise to ignore this opportunity. No other regenerative option allows ISL in such a straightforward manner. If by ISL we mean the transport interface, we need to keep in mind that 3GPP does not specify the transport layer.</p>
<p>16 – Sony Corporation</p> <p>The impact on delay and latency due to ISLs should be taken into account. The focus should be on 3GPP interfaces for ISL and transport being out of scope, very much aligned to current 3GPP working principles.</p>
<p>17 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We support beam management enhancement. Potential aspects include beam management in FDD and potential enhancement including reduced measurement and reporting considering the characteristic of satellite beams</p>
<p>18 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>the previous response should be for enhanced beam management. Please use this response: We see the benefit to support ISL and agree that the detailed impact should be studied further.</p>
<p>19 – Panasonic Corporation</p> <p>We support the moderator way forward to consider the scope and impact for 3GPP first.</p>
<p>20 – TURKCELL</p> <p>It can be merged with regenerative payload item. It should be decided by satellite service providers not 3GPP.</p>

9) Enhanced beam management

Provide comments concerning the moderator way forward on Enhanced beam management.

Feedback Form 34: Enhanced beam management

<p>1 – Apple Poland Sp. z.o.o.</p> <p>Agree with moderator view and this can be restricted to RAN1/RAN2.</p>

<p>2 – ZTE Corporation</p> <p>Agree with moderator and it will be RAN1-led topic. Meanwhile, except for the gap analysis, we need to focus on overall improvement.</p>
<p>3 – Asia Pacific Telecom co. Ltd</p> <p>We agree the way forward.</p>
<p>4 – Lenovo (Beijing) Ltd</p> <p>We prefer beam management to be supported in R18 considering there will be a single cell with multiple beams. We also think this can be considered together with the issue for above 10GHz band</p>
<p>5 – Beijing Xiaomi Mobile Software</p> <p>Agree with moderator’s analysis.</p>
<p>6 – Spreadtrum Communications</p> <p>Agree with moderator</p>
<p>7 – Qualcomm Incorporated</p> <p>This topic has been already discussed in RAN1 with many details, unclear what further details are needed. To summarize, the current beam management procedure does not account for beam management that are not within the same bandwidth – in NTN, each beam will have a different frequency due to the frequency planning.</p> <p>We could write some details down, such as “Enhanced beam management for beams that do not overlap in frequency”. This should make it very clear.</p>
<p>8 – Guangdong OPPO Mobile Telecom.</p> <p>Beam management is important for NTN deployment, especially for frequency reuse case. We support continuing discuss it if some features currently under discussion are not specified in Rel-17, e.g., associated BWP and beam operation, enhanced beam measurement, etc. We also support further beam management enhancements.</p>
<p>9 – DOCOMO Communications Lab.</p> <p>Agree with moderator’s view.</p>
<p>10 – THALES</p> <p>Agree with Moderator’s way forward. A gap analysis is needed</p>
<p>11 – MediaTek Inc.</p> <p>OK with moderator proposal. Better justification is needed, resulting from conclusions of a gap analysis</p>
<p>12 – VODAFONE Group Plc</p> <p>Agree with the way forward for RAN1 to tackle this</p>

<p>13 – Intelsat</p> <p>We agree with the proposed way forward. We agree with Thales that a gap analysis is needed.</p>
<p>14 – Nokia France</p> <p>We do not consider this to be a high priority for Rel-18. It is too early to assess Rel-17 leftovers.</p>
<p>15 – Intel Corporation SAS</p> <p>In our view enhancements for beam management is not essential optimization and can be considered in future releases after Rel-18.</p>
<p>16 – CATT</p> <p>In R17, beam management is not sufficient to support spot beam and non-contiguous coverage. So the demand is clear.</p>
<p>17 – InterDigital</p> <p>Support moderator way forward</p>
<p>18 – CEWiT</p> <p>We are agreeing with moderator and should be included in Rel 18 objective. RAN 1 and RAN2 will be responsible group for this item.</p>
<p>19 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We support beam management enhancement. Potential aspects include beam management in FDD and potential enhancement including reduced measurement and reporting considering the characteristic of satellite beams</p>
<p>20 – TURKCELL</p> <p>We agree with the proposed way forward.</p>
<p>21 – Ericsson LM</p> <p>Enhancements were discussed in Rel-17 without reaching consensus, so it doesn't seem worthwhile to spend more time on this.</p>

10) Introduction of new bands in release-independent manner

Provide comments concerning the moderator way forward on Introduction of new bands in release-independent manner.

Feedback Form 35: Introduction of new bands in release-independent manner

<p>1 – Apple Poland Sp. z.o.o.</p> <p>Support</p>
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<p>2 – ZTE Corporation</p> <p>Agree. It's RAN4 issue.</p>
<p>3 – Lenovo (Beijing) Ltd</p> <p>We are fine with moderator's proposal.</p>
<p>4 – Samsung Electronics Co.</p> <p>Yes, we agree with moderator's recommendation to follow normal RAN4 process.</p>
<p>5 – Qualcomm Incorporated</p> <p>Agree with moderator's way forward</p>
<p>6 – Guangdong OPPO Mobile Telecom.</p> <p>We agree with moderator's view.</p>
<p>7 – Eutelsat S.A.</p> <p>Support the moderator's position.</p>
<p>8 – THALES</p> <p>Agree with Moderator's way forward</p>
<p>9 – MediaTek Inc.</p> <p>OK with moderator proposal</p>
<p>10 – VODAFONE Group Plc</p> <p>Agree</p>
<p>11 – Intelsat</p> <p>We agree.</p>
<p>12 – Nokia France</p> <p>This is business-as-usual in RAN4, subject to noting that for bands above 7 GHz, first the issues of general operation of FDD in FR2 and the handling of 7-24GHz bands would need to be handled and concluded.</p>
<p>13 – CATT</p> <p>Agree with Moderator's proposal.</p>
<p>14 – InterDigital</p> <p>Support moderator way forward</p>

<p>15 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Support the moderator proposal.</p>
<p>16 – TURKCELL</p> <p>We agree with Moderator’s proposal. It belongs to RAN4 group.</p>
<p>17 – Ericsson LM</p> <p>We are OK with the statement.</p>
<p>18 – Fraunhofer IIS</p> <p>We agree with the moderators view, and support the agreed study item (see topic 2).</p>

11) Study of DL PAPR reduction (new waveforms should not be considered in Rel-18)

Provide comments concerning the moderator way forward on Study of DL PAPR reduction.

Feedback Form 36: Study of DL PAPR reduction (new waveforms should not be considered in Rel-18)

<p>1 – Lockheed Martin</p> <p>Lockheed Martin agrees with moderator’s way forward on this topic of ”DL PAPR reduction”</p>
<p>2 – Apple Poland Sp. z.o.o.</p> <p>We do not support this objective at this point due to the high complexity at UE.</p>
<p>3 – ZTE Corporation</p> <p>We share the view from the moderator and no need to further discuss it in Rel-18 with spec effort. The implementation-based solution is up to companies’ own selection.</p>
<p>4 – Eutelsat S.A.</p> <p>Agree with moderator on PAPR WF. We would be interested to understand Apple’s comment on UE complexity as any DL PAPR reduction scheme adopted should be transparent to the UE.</p>
<p>5 – Lenovo (Beijing) Ltd</p> <p>We think this will have large spec impact and prefer it to be addressed in later releases or other dedicated WI.</p>
<p>6 – Samsung Electronics Co.</p> <p>We don’t see a strong motivation of this in NTN.</p>
<p>7 – Qualcomm Incorporated</p> <p>Agree with the moderator’s way forward. Having said this, our understanding is that this item will not have any specification impacts and does not need to be discussed in 3GPP.</p>

<p>8 – Guangdong OPPO Mobile Telecom.</p> <p>We don't see a strong motivation to support this feature.</p>
<p>9 – DOCOMO Communications Lab.</p> <p>Agree with moderator's view.</p>
<p>10 – THALES</p> <p>About Moderator's way forward ("The moderator recommendation is to focus on implementation-specific solutions based on Rel-16 SI outcome given the impact of new waveforms on RAN1 workload (as well as downstream impact on RAN2/RAN4), specification impact, and impact to Rel-17 devices. »). We support a study on this topic to identify what minimum impact could be achieved.</p>
<p>11 – MediaTek Inc.</p> <p>OK with moderator proposal.</p>
<p>12 – VODAFONE Group Plc</p> <p>This is unnecessary complexity and not required at this stage</p>
<p>13 – Intelsat</p> <p>We support this topic, we see it as important to identify DL PAPR solutions that may have minimal impact.</p>
<p>14 – Nokia France</p> <p>We agree with other companies that this should not be included in Rel-18.</p>
<p>15 – Intel Corporation SAS</p> <p>Implementation-based solutions can be used for PAPR reduction. In our understanding there is no urgent need to specify enhancements in Rel-18.</p>
<p>16 – CATT</p> <p>Agree with Moderator's proposal.</p>
<p>17 – InterDigital</p> <p>Not included in Rel-18</p>
<p>18 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Support the moderator proposal.</p>
<p>19 – TURKCELL</p> <p>We agree with moderator's way forward.</p>

20 – Fraunhofer IIS

We do not agree with moderators view.

DFT-s-OFDM is already specified for UL and thus not a new waveform. As an efficient PAPR reduction for satellites (as well as for higher frequencies in general, like beyond 52.6 GHz), applying it to DL as well should be feasible in Rel-18.

12) Study of UE without GNSS

Provide comments concerning the moderator way forward on Study of UE without GNSS and possible objectives for the study item listed below.

- Identify the possible impacts of serving UE without GNSS capabilities
- Enhancements for UL time & frequency sync in idle and connected mode and initial access.
- Coexistence analysis of UE with & without GNSS in a given cell

Feedback Form 37: Study of UE without GNSS

1 – Lockheed Martin

Lockheed Martin agrees with moderator’s way forward listed above.

2 – Classon Consulting

for FUTUREWEI The sum of the proposed NTN scope is very large, this item should not be included even as a study.

3 – Apple Poland Sp. z.o.o.

We support this objective from UE power consumption point of view. For this objective, we may consider both uplink time and frequency synchronization, in both RRC idle mode and RRC connected mode.

4 – China Mobile Group Device Co.

As we mentioned in feedback form 29, the resolution for UE location acquisition or UE pre-compensation is needed to discuss. And we could accept a compromise, i.e., lower the priority of the discussion.

5 – ZTE Corporation

We are fine with moderator’s proposal.

6 – Asia Pacific Telecom co. Ltd

We are fine with the way forward.

7 – Lenovo (Beijing) Ltd

We support to study these issues as UE without GNSS is a typical configuration.

<p>8 – Samsung Electronics Co.</p> <p>We agree with Moderator’s WF to study this issue.</p>
<p>9 – Eutelsat S.A.</p> <p>We support the moderator’s proposal (with the note it should also be applicable to IoT - in a similar way IoT was able to re-use NR-NTN techniques in R17).</p>
<p>10 – Spreadtrum Communications</p> <p>We are fine with the way forward.</p>
<p>11 – Qualcomm Incorporated</p> <p>We think the impact of serving UEs without GNSS is well understood, so we would not support doing a study item for this – the needed changes would be to adapt PRACH to account for large time/frequency errors, and the corresponding time/frequency control loops for data. For the normative work, we think this can be lower priority as the main use case is smartphones having GNSS capabilities.</p>
<p>12 – Guangdong OPPO Mobile Telecom.</p> <p>We are fine to study the case for UE without GNSS.</p>
<p>13 – Beijing Xiaomi Mobile Software</p> <p>We are open to discussion this. If the motivation is to reduce the power consumption on GNSS acquisition. More evaluation on the potential gains is needed.</p>
<p>14 – CATT</p> <p>Same handling could be made as “Network based UE location”, a study phase is needed.</p>
<p>15 – DOCOMO Communications Lab.</p> <p>Agree with moderator’s view.</p>
<p>16 – THALES</p> <p>Agree with Moderator’s way forward. We support the objectives listed for the study</p>
<p>17 – MediaTek Inc.</p> <p>Our preference is to retain the Rel-17 assumption i.e. UE with GNSS capability. We do not see strong justification for UEs without such capability. Assuming GNSS capability, it is not crystal clear whether scenarios exist where a GNSS fix cannot be obtained (e.g. no GNSS signal @UE location), while NTN NR coverage exists.</p>
<p>18 – VODAFONE Group Plc</p> <p>This is useful feature however considering the immense workload and time constraints it need to be de-prioritised until the important wide ranging issues have been resolved</p>

19 – Intelsat

Agree with the proposed scope for the way forward.

20 – Nokia France

We agree that a study phase could take place first.

In addition to the above objectives, the following should be included:

- Methods for timing advance estimation for both initial access and connected mode without dependence on GNSS
- Method for Doppler estimation and/or pre-compensation without dependence on GNSS
- Modifications to mobility procedures to avoid dependence on GNSS

21 – Spreadtrum Communications

We are fine with the way forward.

22 – Intel Corporation SAS

As we commented in the previous round, it is not clear for us if there is any benefit to support UEs without GNSS. Given significant standardization efforts required for this item we prefer not to include this item in Rel-18.

23 – Sateliot

We are fine to study the case for UE without GNSS, specially for IoT NTN

24 – InterDigital

Postpone until network-based SI (if approved) is concluded. Based on the fundamental importance of location information in NTN we do not support UEs with no location information and think there would be considerable effort to re-design many of these mechanisms.

25 – HUAWEI TECHNOLOGIES Co. Ltd.

We don't support to have a study item on UEs without GNSS. We don't think a study item is justified with respect to necessity and feasibility.

Our concerns still remain:

- A Rel-18 UE without GNSS cannot get access to a Rel-17 NTN network. The potential cost reduction and potential power consumption reduction due to no GNSS may not justify the limitation of not being able to access Rel-17 NTN network.
- In Rel-17 NTN, UE location is mandatory for UE to get access to the core network, i.e., the User location is needed for RAN to select the AMF CN. If UE GNSS information is not available, we don't see how the UE can even get access to the network!

26 – NOVAMINT

we are ok to have a study for UE without GNSS if it covers both NR & IoT NTN

<p>27 – TURKCELL</p> <p>We agree with moderator’s way forward.</p>
<p>28 – Ericsson LM</p> <p>This would at least require a study item first. Also, this seems to depend on network based positioning, and therefore should be started only after that is stable.</p>
<p>29 – Fraunhofer IIS</p> <p>We agree with moderators approach.</p>

13) Others

Provide comments concerning the moderator way forward on spectrum reuse/sharing.

Feedback Form 38: Spectrum reuse/sharing

<p>1 – Apple Poland Sp. z.o.o.</p> <p>We prefer this item to be moved out of R18 to a future release but are ok with moderator recommendations in case of consensus.</p>
<p>2 – China Mobile Group Device Co.</p> <p>We support this. Because spectrum sharing between NTN and TN is beneficial for improving spectrum utilization.</p>
<p>3 – Rakuten Mobile</p> <p>We would like to propose “TN-NTN Spectrum sharing, co-existence study in Rel-18”</p> <p>There is real use case for this, as many countries would struggle to find a dedicated spectrum for NTN. Rakuten Mobile also plan to utilize existing spectrum from Sattellite Broadband (subject to regulatory approval).</p> <p>Our area of interest is spectrum re-use through Interference co-ordination between TN & NTN. While, we understand that this issue is subject to Regulatory affairs; however we don’t see this as a blocker.</p>
<p>4 – ZTE Corporation</p> <p>it’s premature to discuss this topic in R18.</p>
<p>5 – Lenovo (Beijing) Ltd</p> <p>We think spectrum sharing can be considered later. We are also fine with moderator’s proposal.</p>
<p>6 – Guangdong OPPO Mobile Telecom.</p> <p>We think this can be postponed.</p>

<p>7 – Qualcomm Incorporated</p> <p>Agree with moderator’s way forward</p>
<p>8 – vivo Mobile Communication Co.</p> <p>For spectrum reuse/sharing for NTN and TN, since the majority of companies support coverage enhancement for commercial smartphones, we are wondering how eNR-NTN can support commercial smartphones without this feature. We think the support of NTN deployed on TN spectrum is needed to support access by commercial smartphones, but whether to support the scenario of simultaneous deployment of the two types of NW in a region can be subject to further discussion.</p>
<p>9 – CATT</p> <p>As there’re too many things to do in Rel-18, this could be 2nd priority, or continue in the future release.</p>
<p>10 – DOCOMO Communications Lab.</p> <p>Agree with ZTE. This should be lower priority.</p>
<p>11 – THALES</p> <p>A study could take place to assess the regulatory situations and identify/characterize the relevant coexistence scenarios in order to identify potential gaps</p>
<p>12 – MediaTek Inc.</p> <p>We see this topic is very important for NTN/TN ecosystem and strongly support its inclusion in Rel-18, as explained in the above. We would also like to thank the Rapporteur for including this topic here.</p>
<p>13 – VODAFONE Group Plc</p> <p>Useful study but we also need to take into consideration the Regional and inter-country Regulatory Requirements</p>
<p>14 – Intelsat</p> <p>We support this but perhaps with lower priority.</p>
<p>15 – Nokia France</p> <p>The regulatory issues of TN-NTN spectrum sharing should be assessed and understood in RAN plenary first.</p>
<p>16 – InterDigital</p> <p>Support moderator way forward</p>
<p>17 – Sateliot</p> <p>Agree with moderator’s way forward</p>

<p>18 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We don't support spectrum reuse/sharing between TN and NTN. As pointed out by the moderator, there is a regulatory issue.</p>
<p>19 – NOVAMINT</p> <p>We should probably do a gap analysis first and identify and characterise the relevant coexistence scenarios.</p>
<p>20 – TURKCELL</p> <p>We agree with Vodafone. We need to take into consideration the Regional and inter-country Regulatory Requirements</p>
<p>21 – Ericsson LM</p> <p>OK to study to check if there are any particular showstoppers that need to be addressed.</p>

Provide your views on RedCap extensions to NTN.

Feedback Form 39: RedCap extensions to NTN

<p>1 – Classon Consulting</p> <p>for FUTUREWEI It is probably OK to discuss (somewhere) whether a non-RedCap UE can support the RedCap developed HD-FDD feature.</p>
<p>2 – Apple Poland Sp. z.o.o.</p> <p>Support.</p>
<p>3 – ZTE Corporation</p> <p>The motivation to enable the Redcap over NTN is still now clear. It can be done later once the Redcap is stable in TN. We need to address the main issue for normal UE firstly.</p>
<p>4 – Lenovo (Beijing) Ltd</p> <p>We think NTN should support Redcap UE, and we are fine with moderator's proposal.</p>
<p>5 – Qualcomm Incorporated</p> <p>Agree with moderator's way forward</p>
<p>6 – Qualcomm Incorporated</p> <p>(Please disregard the previous comment, it was intended for a different question)</p> <p>Similar to MBS, a gap analysis should be performed first, and we would be open to discuss potential gaps (if any).</p>
<p>7 – Guangdong OPPO Mobile Telecom.</p> <p>We think this can be postponed.</p>

<p>8 – Beijing Xiaomi Mobile Software</p> <p>It is not clear to us the Redcap extension here means to support the Redcap type of device over NTN or support the Redcap service (as in TN) over NTN.</p>
<p>9 – CATT</p> <p>To narrow down the scope of NTN Rel-18, this could be continued in the future release.</p>
<p>10 – THALES</p> <p>The support of RedCAP in NTN is very interesting. Some gap analysis could be carried to identify what further enhancements are needed to support it in NTN context.</p>
<p>11 – MediaTek Inc.</p> <p>We think our comment on HD-FDD support may have been misunderstood wrt RedCap - it is not a RedCap topic per se: 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.</p>
<p>12 – VODAFONE Group Plc</p> <p>This will depend on use cases whether RedCap devices will be used for this kind of application.</p>
<p>13 – Intelsat</p> <p>We support REDCAP but a gap analysis would be needed.</p>
<p>14 – Nokia France</p> <p>We support studying enhancements to support RedCap UEs accessing NTNs.</p>
<p>15 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We don't support RedCap extension to NTN. This is similar to MBS where gap analysis is required first.</p>
<p>16 – NOVAMINT</p> <p>We support studying enhancements to support RedCap UEs accessing NTNs</p>
<p>17 – TURKCELL</p> <p>We agree with moderator's way forward.</p>
<p>18 – Ericsson LM</p> <p>OK to study to check if there are any particular showstoppers that need to be addressed.</p>

The following final round comments were received from Ericsson over email due to NWM response issues and are included here for information.

FEEDBACK FORM 38

[Please disregard the current comment from Ericsson - wrong form - and substitute with:] We support the first conclusion of the moderator ("defer spectrum re-use discussions until there is a clearer regulatory view on this aspect".) and we would encourage narrowing down the scope of the topic to further focus the discussion (which FR, which band, FDD/TDD, etc.).

3.1.2 Evolution of IoT (Internet of Things) NTN

1) Limited IoT-NTN scope in Rel-18 (focus primarily on remaining issues from Rel-17 and incorporating relevant enhancements from Rel-17 NR-NTN)

Please provide your views on the following possible objectives.

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates
- Improved GNSS operations for a new position fix for UE pre-compensation during long connection times
- Support of (Rel-17) neighbour cell measurements and corresponding measurement triggering before RLF for NTN
- Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN
- Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment
- Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN

Feedback Form 40: Limited IoT-NTN scope in Rel-18 (focus primarily on remaining issues from Rel-17 and incorporating relevant enhancements from Rel-17 NR-NTN)

<p>1 – Classon Consulting</p> <p>for FUTUREWEI of these if something is selected, prefer HARQ disabling.</p>
<p>2 – Apple Poland Sp. z.o.o.</p> <p>We could consider "improved GNSS operations for new position fix for UE pre-compensation during long connection," since we only considered sporadic traffic in R17.</p> <p>We are open for "disabling HARQ feedback to mitigate impact of HARQ stalling on UE data rates".</p>
<p>3 – China Mobile Group Device Co.</p> <p>Support above. And prefer GNSS operation improvement and legacy CHO for eMTC NTN and RLF/reestablishment.</p>
<p>4 – Spreadtrum Communications</p> <p>We fine to discuss the possible objectives listed by moderator. In addition, other non-essential functionalities identified in R17, e.g., high throughput, long time connection, need to be considered.</p>

<p>5 – Samsung Research America</p> <p>We are fine with Disabling HARQ feedback and Improved GNSS operations.</p>
<p>6 – ZTE Corporation</p> <p>We can take the list from moderator as the starting point. Further down-selection, especially for mobility related can be considered later.</p>
<p>7 – Asia Pacific Telecom co. Ltd</p> <p>We support these objectives.</p>
<p>8 – Lenovo (Beijing) Ltd</p> <p>Regarding HARQ disabling, our view is that there is not much benefit as the HARQ process number is relatively small especially for NB IoT.</p> <p>We think NB IoT carrier selection can be adopted during long UL transmission when a UE is out of the coverage due to satellite moving.</p>
<p>9 – Samsung Electronics Co.</p> <p>Support disabling HARQ feedback and Improved GNSS operation.</p>
<p>10 – Qualcomm Incorporated</p> <p>We think the first two bullets are the most important ones. For improved GNSS operations, we would like to add “and reduced power consumption”. Also, does “Improved GNSS operations” also include operation without GNSS at all? (This is related to the point on “power reduction”).</p>
<p>11 – NEC Corporation</p> <p>NEC considers the following topics as our first priority:</p> <ul style="list-style-type: none"> - Disabling of HARQ feedback - Improved GNSS operations - Support legacy (Rel-16) LTE Conditional Handover (CHO) - Support R17 neighbour cell measurements
<p>12 – Guangdong OPPO Mobile Telecom.</p> <p>We are fine with the list of potential objectives.</p>
<p>13 – Beijing Xiaomi Mobile Software</p> <p>We also share the view that the list can be the starting point, further down-selection may be needed.</p>
<p>14 – Eutelsat S.A.</p> <p>Support the moderator’s proposal.</p>
<p>15 – THALES</p> <p>Agree with Moderator’s way forward</p>

<p>16 – MediaTek Inc.</p> <p>We fully support these proposals</p>
<p>17 – VODAFONE Group Plc</p> <p>HARQ disabling is necessary</p>
<p>18 – Intelsat</p> <p>We support this.</p>
<p>19 – Nokia France</p> <p>The list of objectives is much too long. It is too early to decide on any possible scope for further work on IoT-NTN, given the current status of the Rel-17 work item. We suggest to focus on NR-NTN for now.</p>
<p>20 – Intel Corporation SAS</p> <p>In general, we are fine with the listed objectives, but in our view it is better to discuss after Rel-17 WI completion. For example, discussion on UE position fix is still ongoing in the Rel-17 WI so it is not clear whether “Improved GNSS operations” is needed.</p>
<p>21 – CATT</p> <p>Generally, we support the general topic of Mobility enhancements. For the detail sub-objectives, it seems we can start from the bullets listed by the moderator, and it’s not hurry to do down-selection for now.</p>
<p>22 – InterDigital</p> <p>Support the proposed objectives and lead/support WGs</p>
<p>23 – Sony Corporation</p> <p>The IoT-NTN scope should primarily focus on the issues that were discussed in the Rel-17 SI that were not considered to be “minimum essential functionality”. There were issues identified in Rel-17 that need to be addressed to create a desirable workable system, including:</p> <p>Capacity</p> <ul style="list-style-type: none"> - Control / mitigate PRACH congestion after reading SIB for ephemeris information <p>Coverage</p> <ul style="list-style-type: none"> - Support for intermittent coverage / store and forward - Improved UL coverage for eMTC devices operating in CE mode A <p>Battery life</p> <ul style="list-style-type: none"> - Reduction of PDCCH monitoring during round trip time - HARQ enhancements to improve battery life, including the possibility of disabling HARQ feedback <p>Throughput</p>

- Support longer RRC connections. The UE should be able to update synchronization (including reading ephemeris and GNSS measurements, if applicable, in RRC CONNECTED mode)
- Support higher data rate applications (it should be possible to use more of the UL and DL subframes than possible in Rel-17)

Latency

- HARQ enhancements, including study of disabling HARQ feedback

On the list of potential objectives provided by the moderator, we have the following comments:

- HARQ feedback disabling has a minor impact on UL UE data rates. We think this is not significant and hence this is objective is not necessary
- Improved GNSS operations during long connections: support. There need to be opportunities for the UE to update its GNSS position during a long connection
- LTE-CHO: we should see what the outcome of the Rel-17 IoT-NTN work item is. Our preference is that this is already supported in Rel-17
- Mitigate packet interruption: we do not understand what this objective means. Why does this apply only to NB-IoT and not also to eMTC?

24 – NOVAMINT

We believe there is a misinterpretation and some confusion related to the answers on this topic.

Yes we need to address some remaining issues from Release 17 however this should not be limited to that and Release should not be a Release 17.2. Release 17 was only focus on essential features and feasible in a limited time to ensure a first version to be already offered to the market in the 2023+ horizon.

Release 18 needs to consider the commercial perspectives at the horizon 2025+ for 3GPP to be competitive. So we propose to do some some small enhancements based on existing features to stabilise release 17 as well as to address key (new) features purely related to the non terrestrial (such as Support for store-and-forward on-board NTN payload and Further enhancement to discontinuous Coverage) which will provide competitive answer from 3GPP.

So we would suggest to rename this topic as “Remaining issues from Rel-17” with small enhancements based on existing features without limiting the scope to only those items and to focus on Support for store-and-forward on-board NTN payload and Further enhancement to discontinuous Coverage.

25 – HUAWEI TECHNOLOGIES Co. Ltd.

We don't think the following bullets are remaining issues from Rel-17 IoT-NTN or NR NTN.

- Support of (Rel-17) neighbour cell measurements and corresponding measurement triggering before RLF for NTN
- Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN
- Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN

26 – Gatehouse Satcom A/S

Support the way forward, though agree to that the keywords for Rel-18 for IoT NTN should be linked to capacity, coverage, battery life and throughput. This aspects has not been adequate covered within Rel-17 due to the minimum essential functionality focus. Here the Store&Forward should be seen as necessary.

27 – TURKCELL

We agree with Moderator’s proposal.

2) Mobility enhancements

Please provide your views on the following possible objectives.

- 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
- Neighbour cell measurements and corresponding measurement triggering before RLF
- Enhancements on RLF and RRC reestablishment
- IoT-NTN and TN mobility enhancement
- Beam-level mobility
- Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells

Feedback Form 41: Mobility enhancements**1 – Lockheed Martin**

Lockeed Martin supports the general topic of Mobility enhancements, in particular objectives 1 & 4.

2 – Apple Poland Sp. z.o.o.

Agree with moderator’s views.

3 – China Mobile Group Device Co.

We have a little preference to the first three objectives.

4 – Spreadtrum Communications

We fine to discuss the possible objectives listed by moderator in R18.

5 – ZTE Corporation

We share the views from moderator and further discussion on the above list is needed.

<p>6 – Asia Pacific Telecom co. Ltd</p> <p>We support these objectives. thanks.</p>
<p>7 – Lenovo (Beijing) Ltd</p> <p>We are fine with moderator’s proposal.</p>
<p>8 – Samsung Electronics Co.</p> <p>Not a priority in Rel-18</p>
<p>9 – Qualcomm Incorporated</p> <p>We think the first can be considered. “Beam based mobility” can also be considered to reduce involvement of RRC for mobility especially in moving cell scenario. We are unclear on other items. E.g. what does “RACH congestion reduction” mean? If it is meant to be RACH congestion during handover, then a minor enhancement such as random backoff can resolve issue which is under discussion for Rel-17 NR NTN. Also, reducing HO signalling overhead seems to be already covered by the first bullet, because NR NTN has already considered possible solutions in that direction. Similarly “enhancement on RLF and RRC reestablishment” and “IoT-NTN and TN mobility enhancement” would also fall in the same category – if NR NTN finds/found some solution, that can be made applicable to IoT NTN with necessary optimization.</p>
<p>10 – NEC Corporation</p> <p>NEC supports the general topics of mobility enhancements.</p>
<p>11 – Guangdong OPPO Mobile Telecom.</p> <p>We are fine with the list of potential objectives.</p>
<p>12 – Beijing Xiaomi Mobile Software</p> <p>Geneally fine with the list.</p>
<p>13 – THALES</p> <p>Agree with Moderator’s way forward</p>
<p>14 – MediaTek Inc.</p> <p>We support the first, fourth and fifth objectives</p>
<p>15 – Intelsat</p> <p>We support this.</p>
<p>16 – Nokia France</p> <p>The list of objectives is much too long. It is too early to decide on any possible scope for further work on IoT-NTN, given the current status of the Rel-17 work item. We suggest to focus on NR-NTN for now.</p>

<p>17 – Intel Corporation SAS</p> <p>In general, we support the mobility enhancements. Enhancements that were defined in R17 NR NTN and were not introduced in IoT NTN should have higher priority.</p>
<p>18 – CATT</p> <p>We support the mobility enhancement objective, further discussion on the above items are needed.</p>
<p>19 – InterDigital</p> <p>Support most of the proposed objectives and lead/support WGs. We think mobility enhancements other than CHO (e.g. TN mobility enhancement/beam level mobility) is more of an optimization and not necessary on top of enhanced CHO.</p>
<p>20 – Sony Corporation</p> <p>We are OK with the list of objectives, but there should be down-selection.</p> <p>The RACH congestion issue is not specific to mobility. There is also likely to be RACH congestion after UEs read SIB ephemeral information before UL transmission. We do however agree that there will also be RACH congestion when multiple UEs move from one satellite beam / cell to another.</p>
<p>21 – NOVAMINT</p> <p>We believe it is important to address as higher priority the objective associated to beam-level or based mobility and multiple satellite beams in one cell in order to optimize mobility signaling overhead and efficiency to avoid cell change when beam changes.</p>
<p>22 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>The listed objectives are not in the same level of details. We are fine with the first bullet.</p> <p>The following bullets are not relevant to mobility enhancement</p> <ul style="list-style-type: none"> – RACH congestion reduction – Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells <p>The following are lack of details</p> <ul style="list-style-type: none"> – Reduce handover signaling overhead – Enhancements on RLF and RRC reestablishment – IoT-NTN and TN mobility enhancement – Beam-level mobility
<p>23 – TURKCELL</p> <p>We support Moderator’s way forward.</p>

3) Further enhancement to discontinuous coverage

Please provide your views on the following possible objectives.

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

- Network-controlled mobility and multiple non-anchor carriers may be taken into account.
- Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage

Feedback Form 42: Further enhancement to discontinuous coverage

<p>1 – Apple Poland Sp. z.o.o.</p> <p>Support but do not think store and forward should be merged here. Both are separate topics of varying usefulness from our view. Also, given most companies agree that discontinuous coverage is present for IoT NTN, we do not see why it should be excluded from NR NTN for R18 as a leftover from R17. We strongly urge the moderator to include this into the NR NTN scope as well.</p>
<p>2 – Spreadtrum Communications</p> <p>We fine to discuss the possible objectives listed by moderator in R18.</p>
<p>3 – ZTE Corporation</p> <p>We are fine to this list but also prefer not to include the store and forward payload.</p>
<p>4 – Asia Pacific Telecom co. Ltd</p> <p>We are fine with these issues.</p>
<p>5 – Lenovo (Beijing) Ltd</p> <p>We are fine with this proposal.</p>
<p>6 – Samsung Electronics Co.</p> <p>We think PUR should be under 1)</p>
<p>7 – Qualcomm Incorporated</p> <p>Agree with the list, but we do not see a relationship of PUR with discontinuous coverage. So this can be decoupled from here.</p>
<p>8 – NEC Corporation</p> <p>NEC supports listed topics of discontinuous coverage.</p>
<p>9 – Guangdong OPPO Mobile Telecom.</p> <p>We are fine with the list of potential objectives, however, R17 outcome should be taken into account.</p>
<p>10 – Eutelsat S.A.</p> <p>Support the moderator’s proposal. We would further add that we consider the Store-Forward study as very important and one which could be expected to benefit from the NR study on regenerative payload.</p>

11 – Beijing Xiaomi Mobile Software

We generally fine with the list. We see a connection between store and forward payload and discontinuous coverage and thus it is OK to merge these two topics

12 – THALES

Agree with Moderator’s way forward to merge store and forward with discontinuous coverage. Unlike for NR-NTN, the targeted regenerative payload scenario for NB-IoT/NTN is clear with a preference for eNB on board. For eMTC/NTN the preferred architecture split between ground and space needs further discussion.

13 – Sateliot

Fully support to handle further enhancements to discontinuous coverage in Rel-18. We would also support the consideration of store-and-forward operation under this topic, as further elaborated in our answer to 4) below.

Agree with the proposed objectives. Another objective to be considered is:

- Improvement of paging mechanisms to handle discontinuous coverage. (This should be done consistently with the potential solutions worked out at SA level to support discontinuous coverage capabilities at core network level)

14 – MediaTek Inc.

Further enhancements for discontinuous coverage can be investigated, however R17 outcome should be taken into account

15 – Intelsat

We support this.

16 – Nokia France

The list of objectives is much too long. It is too early to decide on any possible scope for further work on IoT-NTN, given the current status of the Rel-17 work item. We suggest to focus on NR-NTN for now.

17 – Intel Corporation SAS

We are fine to study the listed topics considering related outcome of Rel-17.

18 – CATT

We are fine with Moderator’s proposal.

19 – InterDigital

Support the proposed objectives and lead/support WGs

20 – NOVAMINT

We support the proposal with those proposed objectives as it is important for commercial perspectives. We also do agree it will be beneficial to add the objective of “Improvement of paging mechanisms to handle discontinuous coverage”.

21 – Sony Corporation

Support for discontinuous coverage is important.

PUR does not seem to be an issue related to discontinuous coverage and may be supported in Rel-17 anyway, according to ongoing discussions in RAN1 / RAN2.

22 – Gatehouse Satcom A/S

We support the proposal.

23 – HUAWEI TECHNOLOGIES Co. Ltd.

We share the view that this needs to be discussed together with store-and-forward on-board NTN payload. However, there is a fundamental UE reachability issue which will impact core network which should be taken care of by SA. We understand there are some discussions in Rel-17 SI and WI on some RAN originated proposed such as enhancement to power saving mechanisms including eDRX/PSM/PUR. However, it is a bit too early to set up a study without the knowing the impact on SA

24 – TURKCELL

We support Moderator's proposal

4) Support for store-and-forward on-board NTN payload

Please comment on the moderator way forward and possible objectives below assuming regenerative payload should be considered.

- Support of decoupled signalling procedures “UE <-> Satellite” and “Satellite < CN ground” for achieving end-to-end functionality.
- Address dynamic attachment between S-GW and eNB
- Network identity handling, cell activation associated to moving RAN nodes.
- UE power saving

Feedback Form 43: Support for store-and-forward on-board NTN payload**1 – Lockheed Martin**

Lockheed Martin supports the moderator's way forward.

2 – Apple Poland Sp. z.o.o.

Disagree. We dont see this item being at the same priority as enhancements for discontinuous coverage. Also, as the moderator mentions, this item has heavy SA/CT impact and we prefer this (if agreed and consensus reached) be started in those groups first.

3 – ZTE Corporation

Disagree and prefer not to discuss this feature in Rel-18

4 – Lenovo (Beijing) Ltd

We think this store and forward on-board NTN should be supported.

5 – Qualcomm Incorporated

Agree

6 – Eutelsat S.A.

Support the moderator's WF.

7 – THALES

Agree with Moderator's way forward

8 – Sateliot

First, we would like to stress the relevance of the support of store-and-forward operation for IoT services, since it will allow providing service coverage to areas where Ground Stations (GS) cannot be deployed, e.g. deep-sea maritime areas. Therefore, store and forward operation would allow reducing the ground segment complexity for IoT NTN and reach global coverage with a limited number of GS. Indeed, as expressed in previous comments, store-and-forward operation is already the native operation method used by other protocols competing for the low-cost satellite IoT market.

From such perspective, our understanding is that the concept of store-and-forward operations is different from the concept of discontinuous coverage, at least, from how discontinuous coverage is being treated under Rel-17. Indeed, under Rel-17, discontinuous coverage is more associated with reducing the complexity of the space segment (e.g. enabling sparse LEO satellite constellations with intermittent satellite visibility on a given service area) as well as with enabling dynamic re-configurations of the satellite coverage footprint (e.g. beam re-configurations in GEO systems). Moreover, discontinuous coverage, as being developed in Rel-17, is not tied to any particular network implementation (i.e. discontinuous coverage is applicable for transparent payload systems -which is the current working assumption- but it is also applicable to solutions with regenerative payload). In contrast, the support of store and forward operations is closely tied to architectures based on the use of regenerative payloads.

Noticing these differences, we could support the proposed WF by the moderator to treat store-and-forward operation for IoT services as part of the further enhancements to discontinuous coverage, if the "discontinuous coverage" concept is treated under Rel-18 with a broader view that includes both the discontinuity of service link and the discontinuity of the feeder link. This seems to be also the view of some companies that propose to put under the same umbrella the case of discontinuous radio coverage and discontinuous feeder link/backhaul.

In any case, we feel that the central objective is:

- Support of decoupled signaling procedures "UE <-> Satellite" and "Satellite < CN ground" for achieving end-to-end functionality. (e.g. a UE should be able to interact with a satellite that has no active feeder link connection to any GS, and the UE data should be stored onboard the satellite until a feeder link is available and transferred/retrieved from the ground).

The support of store-and-forward operation has important dependencies with the potential SA architectural enhancements for NTN access to be addressed in Rel-18.

<p>9 – VODAFONE Group Plc</p> <p>Leave this to implementation</p>
<p>10 – Intelsat</p> <p>We support this.</p>
<p>11 – Nokia France</p> <p>It is too early to decide on any possible scope for further work on IoT-NTN, given the current status of the Rel-17 work item. We suggest to focus on NR-NTN for now.</p>
<p>12 – InterDigital</p> <p>Support moderator view that this should wait for outcome of input to Regenerative payload topic.</p>
<p>13 – CATT</p> <p>Support this objective, coordination with SA/CT seems needed.</p>
<p>14 – NOVAMINT</p> <p>We appreciate the details provided by Sateliot on explaining the merits and benefits of store-and-forward on-board NTN payload.</p> <p>We will add the following: we have to consider commercial perspectives: Regenerative payload is already a reality used in non 3GPP IoT NTN. It allows cost reduction, less dependencies to deploy many ground stations (which is deemed to be an issue in the coming years), deployment of those in appropriate locations in particular for cooperation with mobile operators or to simply provide service coverage to areas where gateway cannot be deployed, e.g. deep-sea maritime areas as pointed out by Huawei previously.</p> <p>Support for store-and-forward on-board NTN payload is an essential feature at the horizon of the Release 18 deployment (2025+). It is not completely linked to discontinuous coverage so it could be a separate topic.</p> <p>We believe we should prioritize the objective of the decoupled signalling procedures “UE <-> Satellite” and “Satellite < CN ground” for achieving end-to-end functionality.</p>
<p>15 – Sony Corporation</p> <p>Support.</p> <p>These objectives are generally part of the “discontinuous coverage” objectives in our view.</p>
<p>16 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>We think the support for store-and-forward on-board NTN will have a significant specification impact. The implication is very unclear to us now, e.g. what is the role of the satellite, how network architecture and protocol stack will be impacted and how this will impact the existing gNB and UE implementation, etc. Overall, this requires some further study to understand the impact on network architecture, RAN functionality and core network changes in order to support decoupled signaling procedures between UE and satellite and between core network and satellite.</p>

17 – Gatehouse Satcom A/S

We support this forward, with agreeing to the statement made by SATELIOT. Cooperation with SA/CT is highly recommended.

5) Preconfigured Uplink Resource

Provide comments concerning the moderator way forward on Preconfigured Uplink Resource.

Feedback Form 44: Preconfigured Uplink Resource

1 – Apple Poland Sp. z.o.o.

Agree with moderator’s views.

2 – Samsung Research America

No strong view, but preconfigured Uplink Resource could be considered under topic 1) in case the ongoing Rel-17 work is not concluded, with the scope to support R15 functionalities in NTN.

3 – ZTE Corporation

Agree but the potential enhancement should be justified based on the progress in Rel-17

4 – Lenovo (Beijing) Ltd

We are fine with moderator’s proposal to merge this to discontinuous coverage.

5 – Qualcomm Incorporated

We prefer to study PUR as leftover from Rel-17 and as part of evaluating all the existing IoT features up to Rel-17 case by case, for example UP C-IoT optimization, RRC_INACTIVE. PUR can also be useful when there is no discontinuous coverage, and we fail to see a direct relation of PUR with discontinuous coverage.

6 – NEC Corporation

NEC supports to merge this topic with further enhancement to discontinuous coverage.

7 – Guangdong OPPO Mobile Telecom.

We agree with moderator’s view.

8 – Eutelsat S.A.

We would prefer to see PUR as just one possibility considered as part of a wider study to enhance the uplink performance (link budget, signalling load and capacity). Applicability, if any, of PUR ‘as-is’ to LEO / NGSO needs anyway to be clarified in R17.

9 – Beijing Xiaomi Mobile Software

Agree with moderator’s analysis, can be merged with discontinuous coverage.

<p>10 – THALES</p> <p>Agree with Moderator’s way forward</p>
<p>11 – VODAFONE Group Plc</p> <p>Useful feature and agree to have this</p>
<p>12 – Intelsat</p> <p>Agree</p>
<p>13 – Intel Corporation SAS</p> <p>Some discussion on PUR is ongoing for Rel-17 IoT-NTN WI (at least in RAN1). So, PUR can be supported in Rel-17 for NTN. Thus, we can discuss this item after Rel-17 WI completion.</p>
<p>14 – CATT</p> <p>Agree with Moderator’s proposal.</p>
<p>15 – NOVAMINT</p> <p>We agree with the moderator recommendation to merge PUR with Further enhancement to discontinuous coverage and other related power saving features as part of Rel-18.</p>
<p>16 – Sony Corporation</p> <p>PUR is not part of discontinuous coverage. In any case, PUR may be supported in Rel-17 anyway, according to ongoing discussions in RAN1 / RAN2.</p>
<p>17 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Support the moderator proposal</p>

6) Power reduction for IoT NTN devices

Provide comments concerning the moderator way forward on Power reduction for IoT NTN devices.

Feedback Form 45: Power reduction for IoT NTN devices

<p>1 – Apple Poland Sp. z.o.o.</p> <p>Do not understand completely the moderator views. We prefer this item to be part of the overall IoT NTN WI.</p>
<p>2 – China Mobile Group Device Co.</p> <p>Power saving enhancement is necessary for IoT-NTN devices. We suggest to discuss it with high priority.</p>
<p>3 – ZTE Corporation</p> <p>I’m a bit confused about the moderator’s proposal. Further optimization on the power consumption in NTN is mainly due to the introduction of new feature, e.g., GNSS based precompensatio and others. For</p>

the legacy UE in TN, the needs for further enhancement is not strong. We still prefer to take this aspect within the scope of Rel-18 Iot-NTN as the leftover from previous release.

4 – Lenovo (Beijing) Ltd

We think power reduction is an important feature. We prefer this is kept within IoT NTN scope as there are some IoT specific issues, such as HD-FDD and large propagation delay

5 – Qualcomm Incorporated

If operation without GNSS/reduced GNSS is captured in the 1st area, we are OK.

6 – Guangdong OPPO Mobile Telecom.

We agree with moderator's view.

7 – Eutelsat S.A.

Support the moderator's view (from my reading the intent is to ensure power reduction is considered across all the other items).

Long battery life/ power reduction is important so will be a repeated theme when we evaluate any new technique (cost-benefit analysis if there is a trade-off between system performance and device battery life will need to be carefully considered).

8 – Beijing Xiaomi Mobile Software

This can be merged to discontinuous coverage. Not sure a separate power saving topic in IoT NTN is needed or not.

9 – THALES

Agree with Moderator's way forward

10 – MediaTek Inc.

OK with moderator proposal

11 – VODAFONE Group Plc

Agree

12 – Intelsat

Agree

13 – CATT

Agree with Moderator's recommendation.

14 – NOVAMINT

We agree with the moderator recommendation: the power reduction enhancements for IoT NTN are already covered in the proposed objectives in the other topics in particular in "Further enhancements to discontinuous coverage"

15 – NOVAMINT

We agree with the moderator recommendation: the power reduction enhancements for IoT NTN are already covered in the proposed objectives in the other topics in particular in “Further enhancements to discontinuous coverage”

16 – Sony Corporation

Power consumption reduction for IoT-NTN devices is important, as discussed under the “limited IoT-NTN scope” feedback form.

We do not understand the moderator’s comment about “handle in the SIs / WIs for the specific areas identified as opposed to a separate WI”. We are assuming that there would be a single IoT-NTN SI/WI and there wouldn’t be multiple of them. We also assume that there will not be a separate SI/WI on terrestrial eMTC / NB-IoT that would be dealing with power saving.

17 – HUAWEI TECHNOLOGIES Co. Ltd.

Support the moderator proposal.

7) Introduction of new bands in release-independent manner

Provide comments concerning the moderator way forward on Introduction of new bands in release-independent manner.

Feedback Form 46: Introduction of new bands in release-independent manner

1 – Apple Poland Sp. z.o.o.

Agree with moderator’s views.

2 – Samsung Research America

Fine with moderator way forward.

3 – Qualcomm Incorporated

Agree

4 – Guangdong OPPO Mobile Telecom.

We agree with moderator’s view.

5 – Eutelsat S.A.

Support the moderator.

6 – THALES

Agree with Moderator’s way forward

<p>7 – MediaTek Inc.</p> <p>OK with moderator proposal</p>
<p>8 – Sateliot</p> <p>Agree</p>
<p>9 – Intelsat</p> <p>Agree</p>
<p>10 – Nokia France</p> <p>This is business-as-usual in RAN4, subject to noting that for bands above 7 GHz, first the issues of general operation of FDD in FR2 and the handling of 7-24GHz bands would need to be handled and concluded.</p>
<p>11 – CATT</p> <p>Fine with Moderator’s recommendation.</p>
<p>12 – InterDigital</p> <p>Support moderator way forward</p>
<p>13 – NOVAMINT</p> <p>We agree with the moderator recommendation to follow normal RAN4 spectrum-related WI process for introduction of new bands.</p>
<p>14 – Sony Corporation</p> <p>Agree to follow the normal RAN4 spectrum-related WI process.</p>
<p>15 – ESA</p> <p>Agree with this approach</p>
<p>16 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Support the moderator proposal.</p>

The following final round comments were received from Ericsson over email due to NWM response issues and are included here for information.

FEEDBACK FORM 40

We would prefer handling all GNSS-related issues in the positioning scope. Furthermore, supporting Rel-17 neighbor cell measurements triggering before RLF should be done with minor enhancements to adapt the functionality for NTN. We also wonder about NB-IoT carrier selection based on coverage level: the benefit seems to be limited because the UE will fall back to the legacy paging mechanism (based on UE ID). Frequent cell changes which are typical of NTN limit the usefulness of this feature. On packet interruption mitigation and CHO, we believe both NB-IoT and LTE-M should be in scope.

FEEDBACK FORM 41

"IoT-NTN and TN mobility enhancements" still sounds like quite a broad scope; should be further clarified. Beam-level mobility sounds like a big change for E-UTRA, so we tend to be a bit skeptical on this point.

FEEDBACK FORM 42

We support discontinuous coverage enhancements with the possible exception of PUR, which only seems to work for GEO, where there's no such thing as discontinuous coverage. We would also prefer not to merge with store-and-forward as it is a completely separate topic and would have a significant impact on SA/CT.

FEEDBACK FORM 43

We agree with Apple: We do not support this

FEEDBACK FORM 44

We disagree with the moderator, as PUR is not really useful, in our opinion. See previous comments.

FEEDBACK FORM 45

The moderator's proposal is not clear to us (e.g. which other SI/WIs are being referred to).

FEEDBACK FORM 46

We agree with the moderator.

3.2 Moderator Summary and Conclusions

Many thanks for the constructive feedback in the final round. In accordance with the RAN Chair guidance, I have separated the "non-controversial" and "controversial" topics based on my understanding of the company views expressed during this week. "Non-controversial" does not imply that there is not more work to do to further clarify and to drive to consensus. It is more to refer to topics which seemed to have broad support for consideration in Rel-18. In addition, I have separated the topics which can be covered elsewhere. This may be due to the recommendation to cover the topic in another thread (e.g. RAN4 for new bands) or within another topic within this thread. The moderator summary on the topics and recommendations/conclusions can be found below. In addition, the proposed leading WG and secondary WGs in parentheses for the specific topic area are listed as well as any potential impact to SA/CT.

3.2.1 Evolution of NR NTN (Non-Terrestrial Networks)

Non-controversial Topics

1) Coverage enhancements

RAN1 (RAN2/RAN4)

Possible Impact to SA4

Companies generally viewed this item as critical for Rel-18 and to primarily target low-rate data (e.g. messaging) and voice support for commercial smartphone use case. The moderator recommendation is to consider the list of possible objectives (as a starting point) below and to further refine the list after performing the gap analysis from the general NR coverage enhancement WID. Only items necessary for NTN specifically should remain after the gap analysis. Whether there is a need for a short Study Item for the gap analysis or not is for further discussion based on company views.

- Adapt the work from the general NR coverage enhancement WID and limit work to specific gaps for NTN
- Downlink and uplink enhancements (items to be removed/modified if contained in the general NR coverage enhancement WI):
- repetitions and diversity techniques for the relevant channels (including PRACH and techniques to enable full-power UL transmission and reduced polarization loss)
- [CSI aging mitigation]
- DM-RS config
- Improve the performance of low-rate codecs in link budget limited situation including reducing RAN protocol overhead. (Initial work in RAN1/RAN2 and liaise with SA2/SA4 as necessary)
- Investigate means to mitigate packet interruption due to low DL/UL SNR and beam/cell switching for NTN

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

RAN4 ([RAN1/RAN2])

The moderator view is that this is already confirmed to start work 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
- Specify Rx/Tx requirements for different VSAT/ESIM UE class (not only 60 cm aperture)
- Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed.
- Specify the conformance testing
- Specify the RRM requirements
- Physical layer parameters such as SCS for SSB, data channels
- [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)]

3) NTN-TN and NTN-NTN mobility and service continuity enhancements

RAN2 ([RAN1], RAN4)

Possible SA/CT impact for Mobility and session management

Some companies raised concern about the number of items to consider, the relative priority order of items, and the need to provide further details on each topic. As the intent of this discussion is to provide a framework or skeleton and not to provide a WID/SID draft, we still have more time to discuss the details later.

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.

- Address handover interruption, handover signalling overhead and RACH congestion
- Address RLF reduction issue for different delay and/or network topology between the different access types/points/nodes
- NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements
- [Multi-connectivity for NTN]

4) Network based UE location

RAN1 (RAN2/RAN3/RAN4)

Many companies highlighted the need to fulfil regulatory requirements for regulated services (e.g. lawful intercept, emergency communications, public warning service) as well as handling of requirements where law enforcement apply that the network shall be able to provide a “reliable” UE location (either network verified or network provided). Some companies would like to treat this topic as second priority.

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 would be needed to identify the priority level, clarify the scope and to consider leveraging existing positioning solutions. Further discussion needs to occur at RAN#93-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.

The following topics are considered as being covered elsewhere

5) Power reduction for NTN devices

Based on company views, the moderator recommendation is to leverage existing NR power reduction features as well as any Rel-18 objectives in other topics that reduce power consumption. Any additional enhancements to save UE power consumption can be considered in the objectives of the other Rel-18 topics discussed as opposed to having a separate topic.

6) Introduction of new bands in release-independent manner

The moderator recommendation is to follow normal RAN4 spectrum-related WI process for introduction of new bands. This topic should be covered in RAN4 items.

Controversial Topics

7) NTN-NTN asynchronous multi-Connectivity & Carrier Aggregation

There were mixed views on the urgency of this topic. Many companies would prefer to focus Rel-18 work on essential functionality, performance enhancements, service continuity, and reliability first. The moderator recommendation is to consider Multi-connectivity for NTN in brackets as part of the NTN-TN and NTN-NTN mobility and service continuity enhancements topic and to categorize this as a controversial topic based on the RAN Chair guidance and consider this for further discussion in RAN#93-e.

8) Support of MBS

If necessary, RAN2 (RAN1, RAN3)

The moderator sees interest level for support of MBS focused on public safety needs, software upgrades and multimedia content. A number of companies commented that there may not be any need for NTN-specific work to support MBS and any further enhancements can be considered in a future release. The moderator recommendation is to consider the combined feature set of Rel-17 NTN and Rel-17 MBS as the baseline for MBS support in Rel-18 and to categorize this as a controversial topic based on the RAN Chair guidance and consider this for further discussion in RAN#93-e.

9) Regenerative Payload with Inter-Satellite Link (ISL)

RAN2/RAN3

A few companies do not consider Regenerative Payload as necessary to specify in 3GPP as implementation-based solutions are also a possibility. A number of companies would like to treat ISL with Regenerative Payload as backhaul. However, there is not a consensus view if ISL should be considered within the scope of 3GPP depending on the interfaces that are utilized.

The moderator recommendation is to have further discussions on this topic at RAN#93-e. At RAN#93-e, the group should consider down-selection to one architecture for regenerative payload from TR 38.821 among gNB, gNB-DU, and IAB-like sat. Follow-on WI objectives based on selected architecture would be further discussed prior to the December Plenary meeting. The down-selection could be accomplished via a Rel-18 SI or decided at RAN Plenary to minimize Rel-18 workload to focus on full gNB based on TR 38.821 findings.

10) Enhanced beam management

RAN1 (RAN2)

Some initial items presented by companies in the final round are listed below for further discussions on this topic but are not meant to be a list of objectives at this time until the gap analysis proposed below is completed.

- Enhanced beam management for beams that do not overlap in frequency
- Cover items not specified in Rel-17, e.g., associated BWP and beam operation, enhanced beam measurement, etc.
- Beam management in FDD

- Enhancement to include reduced measurement and reporting considering the characteristics of satellite beams

The moderator recommendation is to leverage beam management enhancements from Rel-17 WI and to consider Rel-17 leftovers in Rel-18. Consideration of a specific NTN WI for this topic should be based on a gap analysis if NR beam management cannot support the NTN use case. Companies are encouraged to perform a gap analysis and evaluate any need to resolve any critical issues for Enhance beam management support in NTN that may not be solved by NR beam management.

11) Study of DL PAPR reduction (new waveforms should not be considered in Rel-18)

RAN1 (RAN2/RAN4)

The majority of the companies expressed concern with specifying new waveforms in the downlink due to impact on Rel-17 devices and backwards compatibility. The moderator recommendation is to defer this topic for Rel-18 and to focus on implementation-specific solutions based on Rel-16 SI outcome given the impact of new waveforms on RAN1 workload (as well as downstream impact on RAN2/RAN4), specification impact, and impact to Rel-17 devices.

12) Study of UE without GNSS

RAN1 (RAN2/RAN3/RAN4)

Possible SA/CT impact for PLMN and core network selection/registration and LCS

Company views vary on this topic including the justification based on cost/complexity and power consumption reduction. GNSS availability is also a concern which could limit existing Rel-17 solution. Any technique for NR NTN might also be able to be re-used for IoT NTN. Any discussion on the priority level in relation to other Rel-18 items to be discussed later given that there was no consensus on the need.

Although there are some companies that do not support this topic due to lack of justification, there seems to be enough support to continue discussions on the topic in the Rel-18 NTN proposals. The moderator recommendation is to consider a study item in Rel-18 depending on further discussions in RAN#93-e and to consider the following list of possible objectives in the study if pursued.

- Identify the possible impacts of serving UE without GNSS capabilities
- Study enhancements for UL time & frequency sync in idle and connected mode and initial access
- Coexistence analysis of UE with & without GNSS in a given cell
- Study methods for timing advance estimation for both initial access and connected mode without dependence
 - on GNSS
- Study methods for Doppler estimation and/or pre-compensation without dependence on GNSS
- Study modifications to mobility procedures to avoid dependence on GNSS

13) Spectrum re-use/sharing:

The moderator recommendation is that the 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 to include the regional and inter-country regulatory requirements. In addition, there could be further down-scoping of the topic to further focus the discussion (which FR, which band, FDD/TDD, etc.) but this should be discussed in the RAN4 topics.

14) RedCap extensions to NTN

Due to the final round introduction of this topic to collect views, the moderator cited the MediaTek proposal to consider HD-FDD capability for NTN UEs by leveraging the RedCap feature. As presented, the moderator proposal and the description provided of RedCap extensions to NTN was perceived by some as support of RedCap devices for NTN which was not the intent. The moderator proposes to continue discussions on this topic at RAN#93-e given the fact that we will not have an extended round per the RAN Chair guidance.

3.2.2 Evolution of IoT (Internet of Things) NTN

Non-controversial Topics

1) IoT-NTN Enhancements in Rel-18 to address remaining issues from Rel-17

RAN2 (RAN1/RAN4)

There was general alignment to focus on small enhancements based on existing features and to further discuss the details of the functionality that was not part of Rel-17 IoT NTN WI and to limited IoT-NTN scope in Rel-18 by focusing primarily on remaining issues from Rel-17 and incorporating relevant enhancements from Rel-17 NR-NTN. Some companies would prefer to discuss after Rel-17 WI completion. Some companies expressed the view that PUR would be more appropriate to consider under this general topic and that there is the possibility of PUR being addressed in 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
- Improved GNSS operations for a new position fix for UE pre-compensation during long connection times and reduced power consumption
- Support of (Rel-17) neighbour cell measurements and corresponding measurement triggering before RLF for NTN
- Support of (Rel-17) NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration for NTN
- Support legacy (Rel-16) LTE Conditional Handover (CHO) for eMTC NTN and RLF/reestablishment
- Mechanisms for NB-IoT NTN to mitigate packet interruption for NTN to mitigate packet interruption for NTN
- Further power saving enhancements including PUR for IoT NTN to support discontinuous coverage

2) Mobility enhancements

RAN2 (RAN1/RAN3/RAN4)

SA/CT impact for mobility/session mobility

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.

- 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
- Neighbour cell measurements and corresponding measurement triggering before RLF
- Enhancements on RLF and RRC reestablishment
- IoT-NTN and TN mobility enhancement
- Beam-level mobility
- Define mechanism to allow UE to continue long PUSCH / PDSCH transmissions between cells

3) Further enhancement to discontinuous coverage

RAN2 (RAN1/RAN3)

SA/CT impact to study the enhancement for discontinuous coverage in SA2 and CT1

General agreement to handle discontinuous coverage in Rel-18 due to limiting functionality in Rel-17 to avoid core network impact while considering the Rel-17 outcome. One company also commented that discontinuous coverage topic should also be considered for Evolution of NR NTN. Additional views were expressed in the intermediate round to treat together with store-and-forward on-board NTN payload topic but not all companies supported that view in the final round. In addition, PUR is removed in the list below as it has been moved to “IoT-NTN Enhancements in Rel-18 to address remaining issues from Rel-17” to keep it generic and address comments from companies that it is not related 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.
- Improvements to UE mobility among sparse cells.
- Network-controlled mobility and multiple non-anchor carriers may be taken into account.

The following topics are considered as being covered elsewhere

4) Preconfigured Uplink Resource

The moderator recommendation is to merge this topic with either “IoT-NTN Enhancements in Rel-18 to address remaining issues from Rel-17” or “Further enhancement to discontinuous coverage as part of Rel-18.” The PUR objective as an option has been included in the moderator views on that topic.

5) Power reduction for IoT NTN devices

Power reduction for IoT NTN devices is seen as an important and necessary. The moderator’s view from the company input is that the power reduction ideas are covered in the proposed objectives in the other topics. The moderator recommendation is to handle in the other topics for the specific areas identified as opposed to having a separate topic.

6) Introduction of new bands in release-independent manner

Moderator recommendation is to follow normal RAN4 spectrum-related WI process for introduction of new bands. This topic should be covered in RAN4 items.

Controversial Topics

7) Support for store-and-forward on-board NTN payload

RAN2 (RAN1/RAN3)

SA/CT impacts for support of regenerative payload

Based on final round company feedback, there were concerns around merging this topic with “Further enhancement to discontinuous coverage” as well as workload concerns due to the impact on SA/CT. Similar views as with Regenerative Payload were presented by companies that it may not be necessary to specify in 3GPP as implementation-based solutions are also a possibility. The moderator recommendation is to categorize this as a controversial topic based on the RAN Chair guidance and consider this for further discussion in RAN#93-e. The following list of possible objectives can be considered during future discussions on this topic.

- Support of decoupled signalling procedures “UE <-> Satellite” and “Satellite < CN ground” for
- achieving end-to-end functionality.
- Address dynamic attachment between S-GW and eNB
- Network identity handling, cell activation associated to moving RAN nodes.
- UE power saving