RAN93e-R18Prep-15-final
Variant of RAN93e-R18Prep-15 Version 0.0.5
RAN

3GPP TSG RAN#93e RP-211665

Electronic Meeting, September 13 - 17, 2021

Agenda Item: 9.0.1

Source: RAN1 Vice-Chair (Ericsson)

Title: Moderator's Summary for Discussion [RAN93e-R18Prep-15] Additional RAN1/2/3 Candidate Topics, Set 2

Document for: Information & Decision

1 Introduction

The discussion in this thread covers the topic #15, "**Additional RAN1/2/3 candidate topics, Set 2**" in [1].

Deadline and NWM organization is based on the guidelines provided by the RAN Chair in [2]. Specifically, the schedule for the different phases of the discussion is as follows.

- Initial email discussions: Mon 8:00 UTC - Tue 12:00 UTC
- Intermediate email discussions: Tue 16:00 UTC - Wed 12:00 UTC
- Final email discussions: Wed 16:00 UTC - Thu 12:00 UTC

As per guidance [1] 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.
- Have a first discussion/identification regarding the leading WG for the respective topics
- Identify potential impacts/interactions with other TSGs (SA/CT)

The set of topics in Set 2 are

- UAV (Unmanned Aerial Vehicle)

- IIoT (Industrial Internet of Things)/URLLC (Ultra-Reliable Low-Latency Communication)
- <5MHz in dedicated spectrum
- Other IoT enhancements/types
- HAPS (High Altitude Platform System)
- Network coding

In the following the different phases of the discussion are organized into different sections.

2 Initial Round

As per the timeline for the email discussion, inputs during the initial round should be provided by 12:00 UTC on Tuesday.

2.1 General Views

Companies are invited to provide their general views on the additional RAN1/2/3 candidate list of topics in Set 2 in the feedback form below.

Feedback Form 1: General Views

1 – Nokia Germany General comment: we believe RAN should set aside dedicated capacity for doing RAN-related aspects for SA-led work. It is FFS what exact work this entails, and is subject to discussions and decisions primarily in SA, but potential areas not covered by the dedicated email threads are e.g. Slicing, Time Resiliency, MUSIM. Note: this comments is made to both Set 2 and Set 3 email threads, it is equally relevant to both.
2 – Intelsat We believe a HAPS SI should be considered. There are several topics that are important for HAPS including, - HAPS deployment and configuration scenarios - Mobility and interference studies - Applicability of regenerative payload as well as transparent payload - Co-channel interference avoidance/mitigation - Inter-HAPS link and/or HAPS radio interface - Overhead and latency optimization
3 – FirstNet Providing advanced technology tools to First Responders is of paramount importance to save their lives and in turn save our lives.

4 – Apple Italia S.R.L.

5 – Huawei Tech.(UK) Co.. Ltd

Regarding Nokia's comment on capacity, we understand the RAN leadership would anyway set aside some capacity as usual, considering the potential impact from SA. In our observation, as Nokia pointed out, we think some topics are still under discussion in SA1/SA2/SA3, and the impacts to RAN are not clear. Thus we think these topics are better to be postponed until the status becomes clearer in SA. However we'd like to point out that the MUSIM discussion from our view is not dependent on SA, the proposals from companies are largely to support UE capability coordination within RAN, which is not relevant to SA. MUSIM should be discussed under set 3.

6 – Ericsson LM

We agree with FirstNet that NR development for mission critical communications is of great importance. In the IIoT/URLLC section, we proposed adding objectives to support enhanced priority handling for mission critical users/services.

2.2 UAV (Unmanned Aerial Vehicle)

Any proposals for areas or objectives on the topic of unmanned aerial vehicles can be provided below.

Feedback Form 2: Proposals for UAV

1 – SoftBank Corp.

We support a new WI for UAV. RP-192451 (the latest WID proposal) can be the starting point of our discussion.

The objective is to specify the following improvements for enhanced NR support for aerial vehicles:

- Aerial UE-specific reporting [RAN2]:
  - Height by introducing a UE-triggered measurement report when the UE is above a configured height, or below a configured height, as for LTE measurement events H1 and H2.
    - Inclusion of height, location and speed of UEs in the measurement reports
  - flight path reporting
- Subscription-based identification [RAN3/RAN2]:
  - Specify NG/Xn signalling to support subscription-based aerial UE identification

Note: Interaction with SA2 regarding this objective is needed.

- Small RRM or mobility enhancements, for instance controlling the amount of measurement reports [RAN2]

2 – Ericsson LM

We also support a UAV WI for Rel-18. And as indicated by Softbank, the LTE work done in Rel-15 is a good starting point.

The LS in S2-2009228 lists as one system enabler a support for UAV to ground identification (e.g. to authorized third parties such as police devices). United States Federal Aviation Administration (FAA) has issued a requirement that broadcast ID is now mandatory for all unmanned aircraft except for a few exceptions. To support the drone identification for NR, we believe we need to add this objective for both LTE and NR:

- Support for UAV to ground identification on PC5 [RAN2]
    - Enhance system information to support drone identification using broadcast and groupcast but not unicast.

Also, CHO has been added since the introduction of the LTE UAV WI. Enhancements are needed to make the CHO framework work for UAVs. Further, enhancements to reduce amount of measurement reports were discussed during the LTE UAV SI which could benefit the UAV scenario. We believe we should ass this objective for NR:

- Small RRM or mobility enhancements to for instance controlling the amount of measurement reports or for CHO [RAN2]

We provided a draft WID in RWS-210189.

3 – VODAFONE Group Plc

It seems logical to upgrade NR to the level of functionality already specified for UAV in LTE in Rel 15.

To benefit areas of the world where NR is less widely deployed, other enhancements (e.g. height based measurement report triggers, Conditional Handover improvements) that don't impact the UE's physical layer should be considered for **both LTE and** NR.

4 – AT&T GNS Belgium SPRL

Specify following UAV enhancements using Rel. 15 NR as baseline:

- UE-triggered measurement reports based on configured height thresholds
- Reporting of height, location and speed in measurement reports
- Flight path reporting
- Signaling to support subscription-based aerial UE identification
- Enhancements to reduce volume of measurement reports
- Potential UAV-specific RRM or mobility enhancements
- Support broadcast/groupcast of drone identification information over PC5

5 – InterDigital

WI should primarily focus on adopting existing Rel-15 LTE work to NR. Conditional HO and enhanced measurement reports may additionally be considered, and may use solutions identified in NTN as baseline.

6 – Qualcomm Incorporated

We support a WI on NR UAV. The aim is to make cellular technology the UAV platform of choice, by identifying the necessary features & specifying them in Rel-18 (and subsequent releases), to ensure 3GPP/cellular is competitive viz-a-viz Bluetooth, WiFi, and other proprietary solutions. We emphasize that we should take existing features as baseline, specifically Rel-15 Aerial features defined for LTE and V2X upper layers solutions.

With the above in mind, and considering the recent developments not only in 3GPP but also in regulatory bodies around the world, we think the objectives can be split into 3 areas as shown below:

Uu enhancements: Using LTE Aerial features as baseline, and introducing additional enhancements (if necessary) for support of the following aerial features:

- Aerial UE-specific reporting [RAN2]: E.g., height, location, flight path reporting etc.
- RRM enhancements [RAN2]: E.g., to control the amount of measurement reports.
- Subscription-based identification [RAN2/RAN3/SA2]: Specify NG/Xn signalling.
- Support of enhanced beamforming / beam management for FR1 [RAN1]: E.g., gNB uptilt beamforming, aerial UE spatial beamforming, etc.
- Mobility enhancements [RAN2]: E.g., CHO based on location info, airborne status, height, flight path plan, etc.
- 5GC support [RAN2]: Align LTE specifications to enable UAV support by ng-eNB.

Spectrum aspects [RAN4/RAN2]

- Support use-cases on band(s) allocated primarily for UAS operations.

PC5 enhancements: Using existing V2X solutions as baseline, and introducing enhancements (if necessary) for support of the following aerial features: [RAN2/RAN1/RAN3]

- PC5-based broadcast of remote identification.
- PC5-based Detect-And-Avoid.
  These would require minor SL enhancements to adapt to UAV scenarios, such as 3D zone, UAV-specific assistance info, support of larger range communications.

7 – Verizon UK Ltd

We support a WI for NR UAV. We have seen strong market need for it - LTE UAV is a good starting point but we expect further enhancement in performance. For example, we see a higher number of handover and radio link failure in some test areas and we think enhancement in mobility (e.g., CHO) and connection reliability and UL interference reduction (e.g., beam operation in FR1) . Identification of UAV are important for UAV. The release 15 LTE enhancements for UAV also included power control enhancements - extending the range of P0. We found it would be good to have extension of P0 needs to be considered for NR. We support other features suggested by QC above for use cases on different bands, including bands in FR1/2 and band(s) primarily allocated for UAV operation.

8 – Verizon UK Ltd

We support a WI for NR UAV. We have seen strong market need for it - LTE UAV is a good starting point but we expect further enhancement in performance. For example, we see a higher number of handover and radio link failure in some test areas and we think enhancement in mobility (e.g., CHO) and connection reliability and UL interference reduction (e.g., beam operation in FR1) . Identification of UAV are important for UAV. The release 15 LTE enhancements for UAV also included power control enhancements - extending the range of P0. We found it would be good to have extension of P0 needs to be considered for NR. We support other features suggested by QC in the above, and use cases on different bands, including band primarily allocated for UAV operation.

9 – FirstNet

The benefits that UAV can provide to public safety officials are numerous and very powerful with the potential to do everything from gathering information about a wildfire to find a missing person quicker to ensuring first responders are not putting themselves in harm's way. Hence, we support a UAV WI for Rel-18.

United States Federal Aviation Administration (FAA) has issued a requirement that broadcast ID is now mandatory for all unmanned aircraft except for a few exceptions. To support the drone identification for NR, we believe we need to add this objective for both LTE and NR:

o Support for UAV to ground identification on PC5 [RAN2]

◦ Enhance system information to support drone identification using broadcast and groupcast but not unicast.

10 – Apple Italia S.R.L.

11 – Intel Corporation (UK) Ltd

We prefer that the main scope to be the features specified in LTE UAV WI. The following features are summarized based on LTE UAV features specified in LTE and can be used as baseline.

- Subscription based identification of Aerial UE function
- height reporting based on the event that the UE's altitude has crossed a network-configured reference altitude threshold
- interference detection based on a measurement reporting that is triggered when a configured number of cells (i.e. larger than one) fulfills the triggering criteria simultaneously.
- signalling of flight path information from UE to gNB.
- Location information reporting, including UE's horizontal and vertical velocity.

We are not sure what RRM enhancements should be considered specifically for CHO operation. We think that the current measurement reporting can be still applicable for UAV with the enhancement made in LTE UAV WI.

Regarding PC5 related objective, we could add once the related SA2 SI proposal is approved and concluded.

12 – Samsung Electronics Co.

LTE UAV design can be the baseline for NR UAV design and the following features can be included in the scope of Rel-18 NR UAV:

- UAV-specific measurement event triggering/reporting, as for H1/2 events in LTE
- Flight path reporting

- Signalling support of subscription-based identification
- Enhancements on CHO
- UAV-specific RRM
- Support for UAV to ground identification on PC5 (based on the LS in S2-2009228)

13 – China Mobile Group Device Co.

There is no relevant research on NR UAV so far. While some features and functionalities of UAV have been studied in LTE R15. Considering the more and more mature NR deployment, NR UAV also needs to carry out corresponding research and discussion. Therefore, for NR UAV, the features of UAV discussed in LTE R15 could be the baseline, then consider further enhancements, for example, mobility enhancements(e.g. CHO, group HO), measurement enhancements, UE reporting including location, height, speed, and reliability about flight path, etc.

14 – vivo Mobile Communication Co.

If we have it, we would like to limit the socpe in the first release, i.e., only copy-paste from LTE in the first release.

15 – Spreadtrum Communications

We are open to discuss this topic. If this WI needs to be specified in Rel-18, then using LTE UAV in Rel-15 as the baseline can save the workload of standardization.

16 – Guangdong OPPO Mobile Telecom.

We should first consider reusing what has been well specified in Rel-15 LTE UAV to NR and then study what is the NR specific isssue to be looked into. We agree with other companies that CHO can also be considered in the NR UAV study.

17 – ZTE Corporation

For this topic, we are supportive to trigger it in Rel-18 with consideration on the commercial needs. In general, we agree that the previous works done in Rel-15 for LTE is good reference for NR related work. However, with consideration on needs and new applicable cases in NR, we prefer to investigate more for 5G-Advanced, e.g.

- Optimization on transmission for UE including beam management:
  As one key issue to improve the continuous service for UAV, we prefer to improve the legacy beam management, e.g., during the rising/landing stage and horizontal movement
- To support the platoon communication
  In addition to enable the sidelink due to the requirement on security, we also prefer to investigate the power control related part to avoid the unnecessary interference within the platoon communication and between UAV to others.

18 – Lenovo Mobile Com. Technology

We support to have a WI for NR UAV. UAV features was introduced in LTE system consider its widely usage in reality. Now for NR system, it is also ready for UAV features in RAN consider SA already study the UAS associated functions e.g. Systems Connectivity, Identification, and Tracking for UAS. From RAN perspective and LTE UAV study experience, UAV in NR is expected to cause large interference to

terrestrial UEs because of LOS signal to gNB, and has large signaling overhead for measurement report and poor mobility support. So LTE UAV features needs also be introduced into NR system. Besides, NR specific function e.g. beam management needs also be considered for UAV study. Furthermore, UAV swarm scenario can be studied, in which a group of UAVs may cause even larger interference problem. And UAV based relay can be used for emergence case, which has specific mobility issue.

19 – Telia Company AB

We see that Release 18 should include NR UAV WI with baseline from Release 15 LTE UAV features. Additional features to be discussed based on work load.

20 – Deutsche Telekom AG

We agree with Vodafone: NR UAV should be brought en par with LTE UAV and necessary/reasonable improvements shall be done for LTE and NR consistently. To support UAV in both LTE and NR consistency is needed as coverage might change depending on the UAV use case. We thus support a UAV Rel-18 WI (focussing on enabling with NR what has been defined for LTE with priority and enhancments applicable to both LTE and NR with second priority)

21 – DOCOMO Communications Lab.

We support UAV work for Rel-18, considering the (expected) spread of NR standalone deployment.

The scope mainly should be based on LTE UAV function including:

- Height-, location- and flightpath reporting
- Controlling the amount of measurement reports
- NG/Xn signalling to support subscription-based aerial UE identification

Enhancements considering NR-specific existing functions should also be discussed, e.g.:

- Mobility enhancement e.g. conditional handover for UAVs

22 – TELECOM ITALIA S.p.A.

Same view as Vodafone and others: *Rel-18 WI focusing on enabling with NR what has been defined for LTE with priority and enhancements applicable to both LTE and NR with second priority*

23 – Sony Europe B.V.

Same view as most companies proposals above, and that we generally should address UAV support for NR in Rel-18,

24 – Nokia Corporation

We also support having UAV work done in Release 18 for NR, including adding the same features done for LTE earlier but also to consider enhancements on the connection reliability / interference managements which would be NR specific

25 – HUAWEI TECHNOLOGIES Co. Ltd.

Huawei, HiSilicon Our opinion is very similar to Intel's comment above. We do not think we should include anything else in Rel-18.

26 – Orange

Orange is supportive of specifying in NR the same mechanisms already specified in LTE, i.e. measurement report based on height, flight path reporting and drone identification. It is essential to operators to identify UAV from other devices in order to enforce specific authorisation frameworks for UAV.

2.3 IIoT (Industrial Internet of Things)/URLLC (Ultra-Reliable Low-Latency Communication)

Any proposals for areas or objectives on the topic of IIOT/URLLC can be provided below.

Feedback Form 3: Proposals for IIOT/URLLC

1 – InterDigital

For Rel-18 IIoT/URLLC, the following issues should be considered:

- Support of URLLC in INACTIVE mode
  - Includes control plane latency reduction (e.g. mobility, paging, etc.) and URLLC transmissions in INACTIVE mode.
  - This topic could alternatively be handled in a Rel-18 Small Data WI, as long as URLLC requirements are explicitly included.
- Support of URLLC with high data rates.
  - This is beneficial for XR, factory automation and the like.
- NR-U enhancements
  - Includes URLLC operation in LBE and FBE considering LBT.
  - Enhancements to initial access and operation in wideband carriers.
  - Further enhancements of prioritization considering LBT failures.
- Leftovers from Rel-17
  - Includes CSI feedback enhancements, SPS HARQ-ACK skipping and size reduction, remaining intra-UE multiplexing and prioritization issues, remaining propagation delay compensation enhancements.
  - Enhanced Type-B repetition over multi-TTI PUSCH grants.

2 – Qualcomm Incorporated

In our view, the focus for IIOT/URLLC should be on Sidelink enhancements. For the Uu use cases with IIoT and URLLC, significant work has been done till Rel-17, and we don't see a need for further work in Rel-18.

3 – China Mobile Com. Corporation

1□The study for real-time multiple-UE backup which listed in "others" relevant to this sub-agenda item as well:

2□To ensure the high reliability of data delivery, URLLC was introduced in Release 15, NR URLLC is further enhanced in Release 16 and Release 17 within the Industrial IoT/URLLC work items. RAN or the

UE always transmits duplication data through radio links to the target side simultaneously or within the delay-tolerant time range.

3 However, duplication transmission is not resource-efficient in air interface for network capability and it face the challenge of failing to meet the high reliability depends on the successful reception just relying on only one terminal in real scenarios. Therefore, actually, more than one terminal is deployed and utilized to receive repetitive content to ensure the reliability as backup. However, this results in high cost of existing backup mechanism for high Reliability.

4The above use cases therefore can motivate the introduction of an real-time multiple-UE backup mechanism:

5Under normal circumstances, terminal 1 and terminal 2 are responsible for different services respectively. If the data/signalling can not be successfully received by the terminal 1, then the subsequent associated terminal 2's action is that the terminal2 is to take over or start/activate the service(s) of the terminal1 declaring in abnormal state.

4 – Apple Italia S.R.L.

5 – vivo Mobile Communication Co.

We only see that the UE back-up (collaborative UE) case is useful in R18, we suggest that UE back up case can be combined with UE aggregation because both them belong collaborative UE case.

6 – Motorola Mobility España SA

Study on the URLLC/IoT profile definition:

Sensor and Actuators (S/A) connected to a controller for process automation may require transmitting fewer bytes (i.e., 40-50) of information reliably, however, the latency associated with the communication is not so stringent 100ms but should be deterministic for process automaton use case.

The complexity of the embedded 5G device enabling wireless connectivity in a S/A should take into consideration from factor/size, power consumption, bandwidth, number of RF chain/antennas etc., The URLLC profile definition in 3GPP should be further studied to enable reduced complexity URLLC devices for IIoT applications requiring stringent reliability and not so stringent latency thereby identifying essential features for URLLC UEs to increase the adoption rate of 5G devices for critical communications.

Following Rel-18 objective should be included for URLLC/IIoT:

Study on the URLLC profile definition in 3GPP to enable reduced complexity URLLC devices for IIoT application [RAN1/RAN2]

Sidelink URLLC/IIoT:

Industry 4.0 deployment mainly focuses on using licensed spectrum in FR1. The limited spectrum availability in FR1 to serve multiple Industry 4.0 use case underscores the importance of spectral efficiency.

Use case 1:

PLC connected to a UE controlling various Sensors & Actuators (S/A) utilizing gNB based communication implies extra hops which could potentially be reduced by direct sidelink communication and network can offload some of the URLLC traffic to sidelink to improve resource efficiency.

Use case 2:

Cooperative carrying robots/AGVs exchanging control commands and control feedback using direct sidelink communication.

NR V2X solution addresses various use cases starting from remote driving use case to low latency sensor sharing use case by considering both Uu and sidelink interfaces for communication thereby benefitting the entire V2X ecosystem deployment. Current Sidelink designed in Rel-16/17 fulfills V2X/public safety requirements but does not meet IIoT requirements with respect to latency and reliability. The IIoT ecosystem requires improvement in the sidelink interface to address above use cases requiring critical proximity-based services with stringent reliability and latency.

Hence, improvements in Rel-18 are needed to support IIoT functionality considering the stringent reliability and latency requirements and support of time sensitive networking over sidelink is needed to support deterministic applications.

Following Rel-18 objective should be included for URLLC/IIoT:

1. Study direct sidelink communication for various IIoT use cases by enhancing physical layer reliability and latency of sidelink control/data channel communications

2. Supporting sidelink based time sensitive networking and its potential impact on 3GPP architecture in collaboration with 3GPP SA WG2

Study on the FR2 improvement for URLLC/IoT deployment:

The limited spectrum availability in FR1 to serve multiple Industry 4.0 use cases affects the deployment of various URLLC applications requiring larger packet size and deterministic latency such as gateway type UE connecting multiple Sensor / Actuators using aggregated TSN stream, AR/VR use case etc..

Larger bandwidth in FR2 helps in the transmission of larger packet sizes and offloading traffic from FR1. However, FR2 deployment inside factory suffers from frequent beam blockage due to presence of clutter and movement of robots/AGVs thereby affecting both reliability and availability. Hence study on the enhancements to facilitate FR1 and FR2 CA operation for private networks and improvement in the beam management framework to enable robust communication links would be beneficial.

Study on the NR-U enhancement for URLLC:

In Rel-17 supporting enhancements for IIoT/URLLC operation in a shared spectrum was considered only for UCE (i.e.., controlled environment) and optimization of unlicensed LBT operation for LBE and FBE is necessary in Rel-18 to support IIoT/URLC use cases.

Following Rel-18 objective should be included for URLLC/IIoT for NR-U enhancements:

Support URLLC operation in LBE and FBE considering LBT

7 – DOCOMO Communications Lab.

- Signaling optimization for propagation delay compensation, where PDC is conducted only when it is necessary (i.e. UE is far away from gNB). This would be beneficial for e.g. moving UEs in the factory.
- Sync resiliency in case of radio link failure. Sync failure due to RLF is crucial incident in smart factory use case, which is expected to be recover fast in case of RLF or handover failure.
- Capacity improvement such as CG/SPS enhancements should be covered in XR WI in order to avoid overlapping discussions.

8 – Guangdong OPPO Mobile Telecom.

The requirement on the reliability and latency with high data rates in Rel-18 IIoT/URLLC is similar as XR. To avoid the duplicated study, we suggest to merge them together and handle the majority in XR WI. Besides, as usual, the leftovers from R17 can be continued here, such as SPS HARQ-ACK for jitter.

9 – TELECOM ITALIA S.p.A.

In our opinion the main requirements for IIoT/URLLC fall under the UL enhancement discussion

10 – MediaTek Inc.

Improved DL control efficiency: Due to the high reliability and small packet size, the control-to-data overhead ratio is larger compared to eMBB services;

- **CSI feedback for PDCCH (due to different coding scheme used for PDCCH, and the observed interference on the PDCCH resources is different from PDSCH resources).**
- **Introducing intermediate aggregation levels (limited link adaptation for PDCCH, only 5 aggregation levels, compared to PDSCH).**

11 – CATT

A lot of techniques and enhancements have been specified for URLLC and IIoT till Rel-17. It is better to have some feedback from industry and market before pursuing further enhancements for the same use cases/scenarios. Therefore, proponents are encouraged to show the performance gap between the requirements of the target use cases/scenarios and performance provided by existing techniques to justify the necessity of further enhancements.

12 – Intel Corporation (UK) Ltd

We support a Rel-18 WI for further enhancements of IIoT/URLLC to provide more mature radio design and optimizations for emerging scenarios.

Basic unlicensed operation for IIoT/URLLC use cases in semi-static channel access was introduced in Rel-17. It is necessary to enable URLLC in dynamic channel access and optimize semi-static channel access framework. For example, the reliability and latency of channel access can be further improved, also wide bandwidth operation with respect to LBT success in uplink can be enhanced, and further harmonization with URLLC features can be considered. We therefore propose to add the following objective:

- Unlicensed band enhancements for both FBE and LBE.

Many scenarios of multiplexing of different services at the UE are still unoptimized, e.g. out-of-order operation in DL and UL for mixed traffic at a UE, tighter processing times, overlap of multiple dynamically scheduled PUSCHs with different priorities. In addition, survival time knowledge is beneficial for scheduler to address SPS/CG collisions with further enhanced SPS/CG and dynamic grant operation improving performance of non-zero survival time systems. We therefore propose to add the following objective:

- Enhancements to scheduling & HARQ to address e.g., out-of-order HARQ, tighter processing time, as well as survival time aware scheduling enhancements.

Layer 2/3 can be further enhanced for IIoT/URLLC in Rel-18. One area is UE based PDCP duplication activation/deactivation, which can reduce delay in reacting to the change in radio conditions, compared with MAC CE based activation/deactivation. In addition, PHY layer can be generalized to enable HARQ repetition/retransmission across carriers at least in uplink, including multi-TRP aspects. We therefore propose to add the following objectives:

- Enhancements including UE based PDCP duplication activation/deactivation and PHY cross-CC repetition for uplink.

Combination of Uu and PC5 provides an option to bypass two-hop UL+DL communication protocol and potentially deliver data from one device directly to the other device, e.g., between sensors and actuators. The sidelink connections may be also used to provide redundant packet transmissions, e.g. by PDCP duplication at PC5 and Uu. The sidelink design under network control may require further enhancements for latency reduction and higher reliability, especially considering operation in unlicensed spectrum. Sidelink enhancements (e.g. scheduling enhancements) are needed to support Time Sensitive Communication (TSC). We therefore propose to add the following objective:

- Sidelink URLLC enhancements for IIOT use cases.

13 – HUAWEI TECHNOLOGIES Co. Ltd.

We think the following areas are worthwhile to further discuss for Rel-18 IIoT/URLLC:

Area 1: Cross-carrier HARQ retransmission for TDD with different UL/DL configurations

According to the existing mechanism, the initial transmission and re-transmission for data needs to on the same serving cell, which will result in large latency for data transmission on a TDD cell. For TDD CA with different UL/DL configurations, enabling flexible initial transmission and re-transmission on different serving cells would largely reduce the latency, and thus is beneficial for URLLC.

Area 2: Efficient small packet transmission

For the RT/IRT use cases in smart factory, the data packet size is always small, e.g., 32 or 48 bytes. In this case, the control channel would become the bottleneck from the overhead and reliability perspectives. One direction is to enhance control channel transmission efficiency, e.g., group scheduling, flexible CCE aggregation levels, etc. The other is to enhance flexibility for DL SPS and UL CG, e.g. relaxing the restriction that only the SPS configuration with lowest index can be received when the occasions of different DL SPS configurations collide.

Area 3: FR2 enhancements for URLLC

Due to wide bandwidth of FR2, it is beneficial for URLLC from latency and reliability perspective. However, it is expected that the beam blockage will have large impact on reliability also, which will limit the applicability of FR2 for URLLC. Therefore, it is worthwhile to look for some potential enhancements to improve the reliability to meet URLLC requirement. For example, mechanisms to enable fast identification of beam/panel blocking, or support of larger number of TRPs for joint transmission/reception can be considered.

Area 4: Enhancement for equipment reliability

In industry IoT, redundancy of network and nodes are very important. Although the traditional UE backup scheme can improve UE reliability by duplicating traffic data to two UEs and transmitting by the two UEs, it is very resource-consuming, which will further reduce the already very limited URLLC capacity. Therefore, it is worthwhile to introduce some high-efficient UE backup mechanism to enhance equipment reliability.

Area 5: Enhanced header/data compression with padding removal

In most IIoT control scenarios, the packets from the same source are highly co-related, and tens of padding bytes may exist in the payload. Both the headers and the payloads have room for further compression. Enhanced Ethernet header and data compression with padding removal can be studied in Rel-18 for higher resource efficiency.

14 – Sony Europe B.V.

- Broadband URLLC, i.e. high throughput URLLC transmission (about 200 Mbps).
- High UL throughput in TDD operation, e.g. enhancements to UL > DL split
- Improve OLLA with enhanced CSI-type feedback

15 – Ericsson LM

For mission critical communications, to enable a 5G network to make an early decision on prioritizing mission critical users/services and ensure the flow of mission critical traffic in high load situations, the following objectives should be considered:

- Specify functionality and configurations that will enable networks to identify MC UEs/services using an early indication in Msg1 and/or MsgA PRACH

- Specify functionality and configurations to prioritize reliability/coverage enhancement of transmissions from MC UEs compared to normal UEs

- Specify functionality and mechanisms to support finer priority-level differentiation between different MC UE groups or a finer differentiation granularity for MC services in initial access

More details can be found in our contribution RWS-210328.

For URLLC/IIoT, we see the following:

- CG/SPS enhancements to handle variable packet burst size [RAN1, RAN2]
  - Dynamic free up of configured resources
  - Flexible multi-slot allocation (per TB MCS and per TB repetition)
- RAN2 methods for multiplexing/duplication of URLLC traffic with eMBB in case of M-TRP or for different PUSCHs [RAN2]
  - RLC duplication per TRP/PUSCH or LCH restrictions per TRP/PUSCH to work with PDCP duplication).
- Additional TSN assistance information to RAN for more efficient scheduling, e.g. burst end time, variable burst components (payload variation) [RAN2, RAN3, SA2]
- R17 leftovers (if any):
  - Simultaneous PUSCH/PUCCH, PUCCH/PUCCH (at least inter cell/band).
  - Propagation delay compensation

Also, we think that sidelink and NR-U enhancements are not well justified.

16 – Nokia Corporation

From the different URLLC/IIoT proposals it is hard to identify a single item with wide support, while at the same time items were raised which are covered elsewhere, like with mobility (for example DAPS for FR2) or enhancements also relevant for XR, thus indeed one would need carefull discussion if there is a specific WI for URLLC/IIoT needed in Release 18. One of the items related is the resilient timing, which is being addressed in SA side and RAN should be prepared to cover possible changes needed. We see that we should not have a separate URLLC/IIoT item only for sidelink purposes however. The URLLC UE categories could be discussed in RAN level.

17 – ZTE Corporation

For Rel-18 IIoT/URLLC, the following topics should be considered:

- Capacity enhancements on FR2 (FR2/FR1 CA/DC)
  - CG/SPS has already supported CA/DC, so the enhancement on FR2/FR1 CA/DC will further focus on improving FR2 PDSCH/PUSCH/PDCCH/PUCCH reliability using FR1 as 'anchor carrier'
- Complementary TDD with flexible cross-frequency transmission:
  - Flexible HARQ operation over multiple carriers (cross carriers HARQ)
  - PUCCH repetitions over multiple carriers
  - DG PUSCH/PDSCH repetitions over multiple carriers
  - Resource reduction of multiple CG/SPS configurations over multiple carriers
  - Some related issues, e.g., intra-UE conflicts/multiplexing, type1/2 HARQ-ACK CB in the above cases.
- Rel-17 leftover which depends on R17 discussions, e.g., SPS HARQ-ACK skipping and codebook size reduction, left over cases for intra-UE multiplexing, CSI feedback enhancements
- RRM measurement enhancement to reduce the latency due to the measurement gap
- URLLC profile to identify essential features for UEs. This can be a separate issue other than in Rel-18 WI.

18 – Samsung Research America

After two large releases and absence of identifiable near-term market need for further IIoT-centric enhancements, a Rel-18 WI on URLLC is not well justified. Topics that were not deemed useful to specify in Rel-17 are not a good use of Rel-18 time. Narrow topics for specific applications are best handled as part of corresponding WIs, as appropriate.

19 – FirstNet

For public safety needs, the 5G network should prioritize mission critical services (MCS) over traditional commercial services and ensure these first responder identified UEs have uninhibited data flow even in congested cells.

o Continue to provide additional mechanisms to identify MC subscribers/UEs at the initial PRACH access time

o Provide improved techniques to assure reliable mission critical data flows while the data traffic is allocated appropriate Quality of Service (QoS).

o Maintain mechanisms to support Allocation and Retention Priority (ARP) for different users/user groups and services.

2.4 <5 MHz in Dedicated Spectrum

Any proposals for areas or objectives on the topic of less than 5 MHz bandwidth in dedicated spectrum can be provided below.

Feedback Form 4: Proposals for <5 MHz in Dedicated Spectrum

1 – Nokia France

From the workshop, three use cases create a clear market demand:

- Railway communication & control for FRMCS in Europe (RMR-900 band)
- Smart grid control in US: 2x3MHz FDD dedicated spectrum in bands n8 and n26
- PPDR in Europe: 2x3MHz FDD dedicated spectrum in band n28

Unlike RedCap, these target markets do not have significant constraints on device size, complexity, number of antennas, or power consumption, but the system bandwidth is limited by spectrum allocation.

In view of these markets, we see a clear need for tightly-scoped work in Rel-18, building with maximum commonality on the established NR ecosystem. This could comprise:

1.) Specify necessary changes to NR physical layer with minimum impact to operate in dedicated FDD FR1 spectrum allocations between approx. 3 and 5MHz [RAN1]:

a) Restrict to subcarrier spacing of 15kHz and the use of normal cyclic prefix.

b) For SSB:

- Reuse PSS/SSS specification without puncturing.

- Reuse PBCH specification with puncturing (at least keep RE mapping of PBCH).

c) For PDCCH:

- No new size of CORESET#0.

d) For CSI-RS/TRS:

- Support CSI-RS/TRS with flexible bandwidth between approx. 3MHz and 5MHz.

e) For PRACH

- PRACH format restriction within uplink bandwidths less than 5MHz.

f) For PUCCH

- Specify necessary changes for PUCCH while keeping PUCCH performance, if existing design has limitations (e.g., frequency hopping).

2.) Specify necessary changes to support deploying NR in dedicated spectrum less than 5MHz [RAN4]:

a) Specify system parameters (including channel and sync rasters) for the associated dedicated spectrum.

b) Minimize impact on RF requirements:

- Reuse 5MHz channel bandwidth at least for FRMCS use case (assuming co-located NR and GSM-R with same operator).

- Specify the required RF requirements for 3 MHz channel bandwidth in bands RMR 900, n8, n26 and n28.

2 – Anterix

Anterix has been working with other 3GPP network operators such as the UIC that has oversees railways in Europe, SouthernLinc with operations in 4 US States - in addition to our 900 MHz US nationwide spectrum portfolio. We also want to include PPDR allocations in Europe as part of our consortia showing demand across multiple verticals. These networks are for critical communications in transport, electrical grid and public safety and utilize bands n8, n26, n28 and RMR-900 band.

It should be noted that these are fully functional networks with advanced operations for high speed mobility, QoS and voice. Currently the use of RedCap is not envisioned in initial rollout of devices. The primary goal of this proposal is to provide a migration path for existing 3GPP technologies to 5G NR as system bandwidth is the primary issue.

Current as for this submission the supporting companies include UIC, Nokia, Nokia Shanghai Bell, Qualcomm, SoutherLinc, Anterix, Telit.

- Specify necessary changes to NR physical layer with minimum impact to operate in spectrum allocations between approx. 3 and 5MHz [RAN1]:
  - Restrict to subcarrier spacing of 15kHz and the use of normal cyclic prefix.
  - For SSB:
    - Reuse PSS/SSS specification without puncturing.
    - Reuse PBCH specification with puncturing (at least keep RE mapping of PBCH).

nsate potential coverage loss.

  - For PDCCH:
    - No new size of CORESET#0.
  - For CSI-RS/TRS:
    - Support CSI-RS/TRS with flexible bandwidth between approx. 3MHz and 5MHz.
  - For PRACH
    - PRACH format restriction within uplink bandwidths less than 5MHz.
  - For PUCCH
    - Specify necessary changes for PUCCH while keeping PUCCH performance, if existing design has limitations (e.g., frequency hopping).
- Specify necessary changes to support deploying NR in dedicated spectrum less than 5MHz [RAN4]:
  - Specify system parameters (including channel and sync rasters) for the associated dedicated spectrum.
  - Minimize impact on RF requirements:
    - Reuse 5MHz channel bandwidth at least for FRMCS use case (assuming co-located NR and GSM-R with same operator).
    - Specify the required RF requirement for 3 MHz channel bandwidth in bands: RMR 900 (874.4 - 880 MHz/919.4 MHz – 925 MHz), n8, n26 and n28.

3 – Swiss Federal Railways Ltd

UIC (International Union of the Railways)

Railways in Europe have a strong demand for the support of <5MHz in dedicated spectrum summarized during the first workshop in RWS-210280. The allocated spectrum in accordance to ECC Decision (20)02

in RMR 900 can only be utilized for operational purposes. The use of RMR 900 is extremely important for train protection for FRMCS (Future Railway Mobile Communication System) which is train safety relevant requiring Safety Integrity Level 4 (SIL-4). In order to be able to start with a migration from GSM-R to FRMCS based on 5G technology in 2025, extensive preliminary studies have already been carried out by industrial partners so that normative introduction could start very soon.

4 – Ericsson LM

In general, we are supportive of this work, but we do not see it as very urgent. Hence, we think it is sufficient with a study item starting later in Rel-18 and a follow-up work item in Rel-19.

5 – InterDigital

We see that there is a market demand to deploy NR in dedicated narrowband channels in low FR1. Use cases include railway communications, public safety, and smart grid. A potential SI should focus on expanding NR to these new verticals while minimizing the impact on the NR physical layer. For example, changes to synchronization, PRACH, PUCCH, CSI feedback, numerology, etc., should be minimized or omitted when possible.

6 – Qualcomm Incorporated

We share similar views with Nokia, Anterix and Swiss Federal Railways/UIC.

We have seen a strong/clear market requirement to expand NR support of new verticals for dedicated FDD spectrum in FR1, including railways, smart utilities and Public Protection and Disaster Relief (PPDR) in their own dedicated spectrums.

These use case scenarios have different requirements from (e)RedCap or LPWA, where there are no backward compatible issues in dedicated spectrum, no specific concern on power consumption, cost and complexity. The dedicated spectrum has limited bandwidth with less than 5MHz, smaller than the NR existing minimum bandwidth, is not in the scope of eRedCap discussion either.

Our target is to enable NR with **BW < 5MHz** by reusing existing NR techniques with **minimum changes** by clearly identifying the specific characteristics of these deployment scenarios (e.g., dedicated spectrum, no legacy Rel-15, etc.) & ensure these guide the design activity. We would like to suggest the following items related with RAN1 and RAN4 working groups.

1) Specify necessary changes to NR physical layer with minimum impact to operate in spectrum allocations between approx. 3 and 5MHz [RAN1]:

a) Restrict to subcarrier spacing of 15kHz and the use of normal cyclic prefix.

b) For SSB:

- Reuse PSS/SSS without puncturing

- Reuse PBCH specification with puncturing (at least keep RE mapping of PBCH).

- [Allow power boosting for PBCH to compensate potential coverage loss.]

c) For PDCCH: No new size of CORESET#0.

d) For CSI-RS/TRS: Support CSI-RS/TRS with flexible bandwidth between approx. 3MHz and 5MHz.

e) For PRACH: PRACH format restriction within uplink bandwidths less than 5MHz.

f) For PUCCH: Specify necessary changes for PUCCH while keeping PUCCH performance, if existing design has limitations (e.g., frequency hopping).

2) Specify necessary changes to support deploying NR in dedicated spectrum less than 5MHz [RAN4]:

a) Specify system parameters (including channel and sync rasters) for the associated dedicated spectrum.

b) For RF requirements:

- Reuse 5MHz channel bandwidth at least for FRMCS use case (assuming co-located NR and GSM-R with same operator).

- Specify the required RF requirement for 3 MHz channel bandwidth in bands: RMR 900 (874.4 - 880 MHz/919.4 MHz – 925 MHz), n8, n26 and n28.

7 – Deutsche Telekom AG

We see this being only applicable to very few dedicated bands (as the topic name clearly indicated), e.g. those listed by Nokia.

There shall not be any ”spill-over” in any commercial bands outside these clearly defined dedicated bands, especially not related to terminal capabilites.

8 – Samsung Electronics Co.

Use cases identified for this topic are Railway communication & control for FRMCS, smart grid control and PPDR. We think that some of use cases may need to meet a tight requirement and we are not clear at this point on whether proposals to reuse existing design with puncturing can meet such requirement. Also, since different companies have urgency on their own items, we are not clear on how much this item is urgent as compared to other Rel-18 candidate items.

9 – Huawei Tech.(UK) Co.. Ltd

Limitation of impacts on physical layer design is identified as a key design constraint, and there may be other RAN4 impacts from channelization and sync raster, etc. We are broadly neutral to having this work in Rel-18, but would prioritize RedCap enhancements in general over it, in case of TU limitation. If there is a WI on this topic, it would need to be clear whether access is intended for UEs with bandwidth >=5 MHz (RedCap and non-RedCap), or if there is a preference to allow access to only <5 MHz UEs.

10 – ZTE Corporation

We are also interested in those market demand from vertical industry (FRMCS, smarter grid,PPDR etc) and it would further broaden the NR application to other vertical areas. Since the existing minimum channel bandwidth for FR1 NR is assumed as 5MHz, lots of physical layer design (e.g. SSB) in RAN1 and system parameter (e.g.sync raster, GSCN) in RAN4 are specified based on that baseline assumption, therefore additional standardization efforts would be foreseen to accommodate the new request from vertical industry.

From physical layer design perspective to support such kind of scenarios, we think that both PBCH remapping and PBCH puncturing could be taken into account.

From system parameters perspective, the existing sync raster could be redefined without considering any backward capability issues.

11 – Orange

Orange is supportive of a Rel-18 WI for the specification of narrow band NR for the folloiwng 2 use cases:

- FRMCS in Europe: to enable soft migration from GSM-R, in 850 MHz
- Public Safety / PPDR in Europe: 2x3 MHz in 700 MHz

A commun design principle should be targeted to minimise the specification impact.

2.5 Other IoT Enhancements/Types

Any proposals for areas or objectives on the topic of other IoT enhancements/types can be provided below.

Feedback Form 5: Proposals for Other IoT Enhancements/-Types

1 – Beijing Xiaomi Mobile Software

In accordance with RWS-210251 and also other workshop papers which mention the same or related concepts, we see new use cases and scenarios some of which are already captured by SA1 (e.g., multi-modality interactions, personal IoT, etc.) addressing coordinated parallel transmission, imposing new requirements for 5G system on multi-UE coordination in terms of QoS coordination, traffic switching or data forwarding among UE device(s) associated with the same end user or across multiple end users.

To support multi-UE coordination we propose a work item with an initial study phase to first study and capture the scenarios for multi-UE coordination, and UE device(s) associated with the same end user under the same cell as the first priority.

Based on this, we propose to study and specify:

1) The control plane procedure design for multi-UE coordination, including coordinated RRC connection management for initiated services from the UE device(s);

2) The user plane procedure design for multi-UE coordination, including coordinated scheduling to fulfil the QoS coordination and data forwarding among the UE device(s).

2 – Qualcomm Incorporated

Given the previous input on “other IOT enhancements”, we are not interested in pursuing this item as a Rel-18 work item.

3 – China Mobile Com. Corporation

Considering on the requirements on warehouse management from automotive industry customers, we support to study on Passive IoT, for which there is no battery in the terminal and the terminal accumulate the energy from radio signalling. (RWS-210350)

Currently, in automotive industry, bins are manually managed via scanning the barcode attached on each bin, which results to high OPEX and manual errors. And the current RFID technology is not good enough either, due to high penetration loss and limited coverage due to self-interference. Therefore, we propose to study on Passive IoT to support higher performance and comparable UE cost as RFID.

Here are some requirements for passive IoT from our perspective:

□1□Coverage capability: communication distance should be enhanced to 30 meters to construct a feasible network coverage in the 5000 m2 warehouse.

□2□UE power consumption: <0.1mW to support working without battery.

□3□UE cost: <0.1□(0.02$) to meet cost-sensitive applications.

□4□Positioning accuracy: 3 5m(Horizontal&Vertical) @ 90% for positioning .

4 – Spreadtrum Communications

R18 Personal IoT network considerations:

A user can have many electronic devices, such as smart phone, TV, earbuds, speaker, watch, and AR glasses. The user can switch different devices to display same media, such as voice, video, audio. On other hand, the media may be shared by different devices simultaneously.

In order to achieve the media switching and sharing within the devices in Personal IoT network, 5G network needs to specify some related procedures and introduce some enhancements to guarantee the user experience.

We propose to study and specify:

- Specify device discovery procedure [RAN2]
- Specify negotiation procedure between the devices for service sharing. [RAN2]
- Study CP procedure for service sharing [RAN2,RAN3]

− Specify the paging, UAC and RRC setup procedure, including some potential enhancements considering the assistance information acquired in discovery or negotiation procedures.

- Study UP procedure for service sharing [RAN2,RAN3]

− Lossless switching mechanism for service switching among multiple devices.

− NGU UP tunnel sharing for multiple UEs locate in a same gNB.

5 – Intel Corporation (UK) Ltd

We are interested in exploring new IoT verticals, e.g., passive IoT and energy harvesting based devices, that go beyond RedCap or even LPWA solutions, and target use-cases with extremely low cost/complexity (at least an order of magnitude lower than LPWA solutions) and device power consumption (e.g., 10s of uW). These find applications in very low-end but pervasive IoT solutions, often without batteries, as wireless sensors or inventory tracking devices.
Towards this, careful studies across RAN WGs to establish target performance KPIs and their feasibility would be necessary. We are supportive of having initiating studies on such during the Rel-18 time-frame.

6 – Huawei Tech.(UK) Co.. Ltd

Passive IoT is represented by the attributes of extremely low power consumption (e.g. on the order of 1-100 uW) and extremely low complexity/cost (e.g. on the order of 0.01-0.5$). Passive IoT is expected to have the ability to reach hundreds of billions of connections, covering a wide range of use cases such as:

- Automated asset management in manufacturing, logistics, and warehousing
- Wireless sensor networks in manufacturing, agriculture, and livestock farming

Passive IoT is technology that will ultimately fulfil the 5G vision to connect everything. However, the design targets and use cases of passive IoT have not been covered by existing 3GPP technologies.

Therefore, and given that other technologies are actively seeking to occupy this market space, we think it is a good time for RAN to establish a feasibility study in Rel-18. The RAN WG feasibility study would cover:

- Study the use cases and design targets of passive IoT [RAN1, RAN2, RAN4] or [RAN], including for example

– Power consumption target(s)

– Complexity target(s)

– Link budget target(s)

- Identify the key areas to enhance to achieve the design targets of passive IoT [RAN1, RAN2, RAN4], including for example

– Techniques to achieve the targeted ultra-low power consumption
– Techniques to achieve the targeted low complexity design
– Techniques to achieve the targeted link budget

7 – China Telecommunications

Small size, ultra-low cost, batteryless and sufficient link budget are required in more and more industries applying automated asset management and real-time data report. The current RFID technology has the shortcomings of limited coverage and interference between readers. Aiming no battery or no battery replacement during life time for a device, simply optimization of existing cellular devices is hard to meet the requirements, as the power consumption of existing cellular devices has to be reduced by more than a hundred of times to cooperate with energy harvesting.

Passive IoT is attractive to be studied to establish a new air interface targeting at new IoT markets lower-end than all the existing cellular technologies, most of which require batteryless device for low maintenance cost.

8 – Spreadtrum Communications

Passive IoT: Spreadtrum shares the technical and market views from China mobile, Intel and Huawei about Passive IoT. SA2 has discussed Passive IoT R18 SID proposal(S2-2105610/S2-2106144) in SA2#146e, and there are a lot of explicit supports and interests for Passive IoT in R18. RAN is encouraged to cooperate with SA2 for such efforts.

9 – Motorola Mobility France S.A.S

For passive IoT utilizing technologies like back scattering and/or RF power harvesting it is the goal to support ultra-low cost and power devices. There are many use cases and commercial needs for this new IoT type. It seems to be one of the IoT evolution trends. We are interested to study the detailed use case (e.g., differentiated with NBIoT), traffic/channel model (e.g., frequency band), design target (e.g., coverage, UE power level (without battery), power saving reduction), and related protocol simplifications based on existing RAT.

10 – Ericsson LM

Having looked at the inputs provided under this category and given the already high number of topics for Rel-18, we have not found any proposal within this area that should be prioritized. Hence, we propose not to pursuit any of them in Rel-18 time frame.

11 – Shenzhen YZF Network Technolog

OPPO

ON personal-IoT:

For the Personal-IoT topic, the RAN impact seems a bit unclear at the current stage (or it is not quite clear whether a RAN-based solution is needed, or a SA-based solution is suffient), for both Uu and PC5 interface. Considering that, it is suggested to be of lower priority for now.

On Passive IoT:

Passive IoT uses techniques such as RF power harvesting and backscattering thus it has distinguished characteristics such as battery-less, ultra-low complexity, ultra-low cost, small form factor, washable, flexible and foldable. Therefore, passive IoT have the possibilities to cover the untouched use cases with existing 3GPP LPWA solutions such as NB-IoT and MTC.

Passive IoT would benefit various verticals such as energy, manufacturing, logistics, etc. It also provides promising solutions for applications in individual consumer area such as smart home and smart werables. We believe this can enable/extend the IoT applications for the individual consumer.

12 – NTT DOCOMO INC.

We are technically positive to study Passive IoT, but don't see any urgency.

13 – MediaTek Inc.

On passive-IOT, we see the emerging interest in addressing real-world (industrial) applications. While the service **requirements need continued discussion in SA**, **the power saving aspect looks common with wake-up receiver (WUR) and can be jointly studied in a R18 SI of power saving evolution**. As the power saving item has been carried on in R16 and R17, the R18 SI can leverage the evaluation methodology and system design considerations in developing R16 and R17 power saving mechanisms. It is **beneficial to first enable the ultra-low-power interface and procedures that can be generically applicable to passive IOT and other NR use cases/devices**.

14 – CAICT

Passive IoT will touch some new area not covering by eMTC and NB-IoT and be benifitial for the extension of 5G to various verticals use cases.

15 – ZTE Corporation

Various aspects can be considered to make NR work better for the **massive IoT** scenarios as well as some applications that requires both massive connection and low latency. The following enhancements on connection density and transmission efficiency can be considered as mentioned previously in RWS-210467.

- Enhancements on integration of preamble and DMRS functionality
- Enhancements on PRACH/preamble including perspectives of capacity and latency
- Support of multiple layer transmission in RRC_INACTIVE state
- Sensing based small data transmission *(e.g. LBT applied for CG-SDT)*

Regarding the **passive IoT**, we are open for the study given the market interests. But we think it would be better to do it step by step, i.e., first to study ultra-low power wake up radio.

16 – vivo Communication Technology

There are use cases that requires extremely low cost (<$1) and power consumption (uW level) for UE, which is currently addressed by other technologies like RFID, since 3GPP does not have a technical solution for these scenarios. Passive IOT/Almost Zero Power UE are good candidate techniques for 3GPP to be able to reach these markets thus worthwhile study. The cost, power consumption, link budget would be different for devices with reception only (e.g. for wake-up purpose), or device with reception and transmission

17 – China Unicom

We acknowledge that Passive IoT has the advantages to fulfill the potential marketing demand, such as small size, ultra-low cost and ultra-low power consumption. We propose to study the use cases and design targets first, and then study the potential solutions to fulfill the requirements identified for Passive IoT.

2.6 HAPS (High Altitude Platform System)

Any proposals for areas or objectives on the topic of HAPS can be provided below.

Feedback Form 6: Proposals on HAPS

1 – SoftBank Corp.

HAPS was treated as an "implicit support" in Rel-16 and 17 NTN because doppler shift and round-trip delay will not be a problem. However, it results in the following consequences.

-No deployment scenario(s) defined in TR38.821

-No evaluation efforts except RAN4 co-ex study

-No specific features for HAPS in Rel-17

-Many sentences in TR38.821 applicable to Satellite only, i.e. unclear or not true for HAPS

Now NTN is going to enter optimization phase in Rel-18. Satellites (LEO, MEO, GEO) are ready for optimization, but HAPS is not due to the lack of sufficient study so far. Therefore, we propose to a HAPS SI with the following scope.

- Scope of the Study Item
  - Develop HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821. Following aspects are considered: [RAN1, RAN2, RAN3, RAN4]
    - Determination of HAPS scenario(s) (aircraft type, base stations, architecture) [RAN1, RAN4]
      - KPI of interest may include tx power, beam pattern, etc
    - Co-existence study with other HAPS network and/or TN, i.e. leftover(s) from Rel-17 [RAN4]
    - Mobility and interference study considering spectrum aspect (i.e. overlapping, adjacent and/or separate spectrum) [RAN1, RAN2]
    - Applicability of TDD in addition to FDD from remote interference point of view [RAN1]
    - Direct communication to normal (handheld) UEs [RAN1, (RAN4)]
    - Applicability of regenerative payload as well as transparent payload [RAN2, RAN3]
  - Identify the problems of pre-Rel-18 specifications under the developed HAPS scenario(s) and potential solutions [RAN1, RAN2, (RAN3)]
    - (High priority) Co-channel interference avoidance/mitigation
    - (High priority) Mobility and Beam management
    - Inter-HAPS link and/or HAPS radio interface
    - Coverage and user throughput optimization
    - Overhead and latency optimization
    - UE power consumption optimization

We would like to hear other companies' opinion on the scope, especially the priority.

2 – VODAFONE Group Plc

In the light of many recent "natural" disasters that have impacted (e.g. the power supplies to) terrestrial networks, the use of HAPS to provide (low capacity) communications could be important for 3GPP. However:

a) the work should strongly focussed on the essential tasks for the UE <-> HAPS link,

b) with the disaster relief angle in mind, LTE, NB-IoT and NR should all be considered, including DSS operation of LTE/NR.

3 – InterDigital

We suggest that a HAPS SI first define a typical deployment scenario as in NTN (e.g. altitude, beam diameter, whether cells will be quasi-earth fixed or moving etc.). As Rel-16/17 NTN assumed implicit support for HAPS, we expect many of the solutions defined for NTN would be applicable for HAPS platforms and should be considered as baseline. A primary enhancement however would be support for direct communication to a typical handheld smartphone (i.e. no external antenna), and should be supported in initial release of HAPS.

4 – FirstNet

One of the important applications that the HAPS will support is emergency/public safety communications. HAPS offers certain advantages and at the same time complements satellites and terrestrial infrastructures at relatively low cost. We believe a HAPS study should be considered. The topics that are studied include:

- HAPS deployment and configuration scenarios
- Mobility and interference studies
- Overhead and latency optimization

5 – Qualcomm Incorporated

Although we are interested in the use cases of HAPS, we do not see the necessity of any new features in addition to Rel-17 NR. And we don't see the urgency of starting a project in Rel-18.

6 – Apple Italia S.R.L.

7 – Spreadtrum Communications

For HAPS, we agree that an SI is needed to develop HAPS deployment and configuration scenario(s). Furthermore, the problems and potential solutions identified for NR NTN in TR 38.821 should be considered as baseline.

8 – ZTE Corporation

For this topic, we share the views that some HASP-specific works (e.g., co-channel interference related issues) are still needed according to the previous discussion in Rel-17. In general, to justify the need for HAPS-specific item, it's preferred to clarify the scenarios firstly, e.g., network topology, the assumption for inter-HAPSs link, etc. Otherwise, it's not clear whether the legacy framework defined in NTN is still applicable or not.

In addition, since the R17 NTN work is mainly for FDD, if the TDD is also intended to be supported by HAPS, we can further investigate the required enhancement to improve the performance based on the defined cases.

9 – Guangdong OPPO Mobile Telecom.

In the Rel-17 WID of NR NTN, HAPS scenario has been implicitly supported by the work done for GEO and LEO scenarios, yet no HAPS-specific enhancement is targeted. To start the work on HAPS enhancement, we also think a SI can be considered, e.g. to address HAPS-specific features and consider potential

enhancement directions not covered in Rel-17 NTN. As above companies mentioned, direct communication between handheld devices/smartphones and HAPS should be targeted as it was not well addressed by Rel-17 NTN.

10 – DOCOMO Communications Lab.

We agree with Softbank, i.e. although it is argued that HAPS is implicitly supported in Rel-17 NTN, it would not be the case. There would be some features like feature due to HAPS-specific mobility. At least sufficient study is necessary. In addition, HAPS deployment scenario is typically different from satellite NW. Corresponding enhancement should be identified and studied/specified. The following items are the candidates:

- HAPS scenario
  Many HAPS types/assumptions e.g. moving HAPS, etc. should be considered, which is not enough in 38.821.
- Frequency sharing with TN
  By a single operator, same frequency can be used between TN and NTN.
- Inter-HAPS link/Inter-HAPS-satellite link
  Each HAPS covers narrower area than GEO/LEO, so inter-HAPS link/Inter-HAPS-satellite link is a typical scenario since not so many GWs are assumed (in other words, considering only direct link between GW and HAPS is less efficiency. HAPS-HAPS-GW should be considered as well). We prefer to set this as ”high priority”.
- Regenerative payload
  Necessary for flexible inter-HAPS link.

11 – KDDI Corporation

We support studying HAPS in Rel-18 from aspects of both wider LTE/NR area coverage and recent increasing natural disasters. On the other hand, considering work load of RAN WGs, it would be better that companies focus on only necessary items as 1st phase. Generally speaking, HAPS deployment have issues on frequency overlapping and co-existence which RAN4 needs to study. Therefore, we think that those items seems to be firstly prioritized.

12 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility

Although there are many commonalities between HAPS and NTN, but many fundamental aspects related to HAPS have not been identified and discussed in NTN-Rel 17. For instance, HAPS deployment scenarios have not been discussed and evaluated. Moreover, current NTN Rel-17 discussion is primarily focused on transparent payload while for HAPS, the regenerative payload should be a baseline.

In our view, HAPS should be separated from NTN and a separate SI/WI for HAPS should be considered with at least following enhancements/objectives:

- Identifying the possible deployment scenarios for HAPS e.g., inter-HAPS and intra-HAPS, relay-based architecture, co-channel and adjacent channel scenarios, etc.
  - Note: HAPS can either be used as a standalone communication platform or may be utilized as a relay like architecture to enhance the reliability and coverage, e.g., a HAPS system can serve as an interface to manage the frequent handoffs in the LEO satellite network.
- Identifying and addressing the possible problems for the selected scenarios, e.g.,

- Co-channel interference
- Mobility related issues, e.g., inter-HAPS and intra-HAPS handover
- Impact of HAPS (gNB) instability in stratosphere on beam management

13 – China Unicom

We think HAPS in R17 is not studied well, and a separate HAPS SI is needed in R18. HAPS is expected to be deployed to provide ToB service, ToC service and emergency service. Potential scopes of HAPS in Rel-18 are proposed to be considered:

(a) Evaluation of co-channel interference, adjacent channel interference btw HAPS and TN;

(b) Study and evaluate the impact on the performance caused by the instability of HAPS gNB, e.g. mobility, beam management, and new neighboring cell identification issues;

(c) Study potential solutions to support for normal UE to fulfill the requirements of uplink and downlink link budget.

14 – HUAWEI TECHNOLOGIES Co. Ltd.

We agree with SoftBank that without completing TR38.821 for HAPS scenarios it is difficult for RAN to discuss further work that might be needed for HAPS.

15 – Samsung Electronics Co.

We think that HAPS is part of Rel-17 NR NTN specification works except that spectrum usage will be discussed in next RAN4 meeting. Also, since Rel-17 NR NTN is the worst case in terms of link quality for service link (i.e., NR NTN UEs suffer from longer distance, longer latency and higher Doppler shift than HAPS UEs), we think that solutions identified for Rel-17 NR NTN can be reused for HAPS. So, question is which aspects need to be further enhanced for Rel-18 HAPS on top of Rel-17 NR-NTN, and how Rel-18 HAPS is urgent to be specified.

16 – Ericsson France S.A.S

Although the TRs focus on satellite access, our understanding is that HAPS is implicitly supported in all scenarios. The scenarios mentioned in the discussion are for sure interesting, and different implementations of beam management, coverage optimization etc. may be needed in the network compared to satellite scenarios, but our understanding is that the RAN1-3 specifications are already flexible enough to support such solutions so the issues would be ones of proprietary network implementation, not specifications (HAPS deployments have already been observed to work). If needed, the TR could be updated to indicate that also HAPS has been covered implicitly, but in terms of prioritization it may be better not to spend RAN1-3 time on investigating proprietary issues. For RAN4, co-existence studies for the RF requirements may make sense and need to be considered in the light of the RAN4 workload. If companies believe that there is missing signalling or provisions in the specifications that would prevent operation in relevant scenarios, it would be good to focus this discussion on where those gaps are. Regarding regenerative payload, co-ordination or better still integration of HAPS related considerations into the NTN work should be considered to prevent diverging solutions

17 – Deutsche Telekom AG

Deutsche Telekom support the seperation of HAPS out of NTN into a dedicated SI/WI in Rel-18. We largely support the opinions expresse above from the operators. A well defined market driven set of objectives shall be the basis for a SI/WI which is based on joint NTN (Sat/HAPS) aspects and defines the HAPS specific enhancements. The spectrum specific aspects need to be discussed consitently with NTN in RAN4.

18 – Intelsat

We believe a HAPS SI should be considered. There are several topics that are important for HAPS including, - HAPS deployment and configuration scenarios - Mobility and interference studies - Applicability of regenerative payload as well as transparent payload - Co-channel interference avoidance/mitigation - Inter-HAPS link and/or HAPS radio interface - Overhead and latency optimization

19 – AT&T GNS Belgium SPRL

Apart from some potential RAN4 aspects, it's not clear to us whether HAPS-specific enhancements are needed in RAN 1/2/3. More motivation is needed to justify a full-blown study.

2.7 Network Coding

Any proposals for areas or objectives on the topic of network coding can be provided below.

Feedback Form 7: Proposals on Network Coding

1 – VODAFONE Group Plc

Any study should check whether the solution can also be applied above the point at which flows from any "UE aggregation" are brought back together (e.g. annex F of TS 23.501)

2 – InterDigital

Network coding can be used to improve reliability by using coded redundancy over multiple paths/transmissions.

Network coding can be beneficial for:

- Sidelink (including groupcast/multi-cast) or collaborative terminals
- IAB
- DC/CA
- Factory scenario with multiple backup UEs

A network coding SI should study the layer(s) on which network coding should be performed.

3 – Qualcomm Incorporated

Although there are interesting ideas in this topic, we do not support starting a general "network coding" work in Rel-18. From Qualcomm's perspective, the main interest in this area is about optimizations related to application layer coding in XR. One of the main objectives of this area is to improve performance where HARQ latency or scheduling coordination limitations in a multi-connectivity scenario would make meeting the target latency/reliability KPIs difficult otherwise. We will provide the related input in the corresponding discussion.

4 – Deutsche Telekom AG

Although the topic is interesting in general and there have ben proposals for Rel-17 (i.e. in the area of IAB) the topic has not resulted in huge attraction. We think there is not yet any commercial need and hence we do propose not spending 3GPP effort on this in Rel-18.

5 – Beijing OPPO Com. corp.

From our observation, the performance gain by introducing network coding has not been sufficiently analyzed or evaluated. It seems a bit premature to involve such a new feature as an independent topic into R18 package at the very initial stage. In contrast, we believe a better way is to firstly study whether there is any performance gain and how/when we can get the gain. Then we can try to involve this feature into some limited use cases, e.g., in sidelink(relayed) communication, after confirming the performance gain.

6 – Samsung R&D Institute UK

Network Coding (NC) is an interesting topic with promising benefits in terms of improved reliability and reduced latency.

The study should look into the suitable layer for integration of NC.

7 – Ericsson LM

Having checked the proposals on network coding, we do no support adding these topics in Rel-18. We are not convinced of the need and performance gains are not clear. Introducing network coding in the RAN protocol stack may require further architectural changes mid generation, which are not preferable.

8 – Intel Corporation (UK) Ltd

We support Network Coding as we believe it has a huge potential to increase overall system performance with little impacts. By applying Network Coding into Layer-2 per packet basis, the amount of radio resource usage can be significantly reduced to achieve the same reliability target without sacrificing latency, and those savings are converted to overall system throughput increase. In fact, ”per packet coding” in Layer-2 is not new to 3GPP − we developed packet duplication for URLLC in Rel-16, one form of packet coding but in an inefficient way (i.e. repetition), thus having many limitations. Network Coding could be one enabler to extend beyond blindly duplicated PDCP PDUs over each path in Rel-16 and to allow (1) efficient use of route diversity by considering capacities or trade-off between rate and reliability jointly over multiple paths; and (2) soft combining across packets transmitted over different paths. And from our analysis, the incurred overhead is almost negligible (compared to the gain we can obtain) with reasonable computation complexity. We can avoid high cost direct computation for encoding and decoding operations and minimize latency impact by table look-up method. We thus believe it is worth investigating the potential benefits of applying Network Coding into Layer-2 and initiate a study in RAN WGs with the following goals:

- Identify and evaluate scenarios (e.g. URLLC, DC, IAB, etc.) where Layer-2 packet coding can be introduced with benefits
- Identify architecture and protocol impacts for applying Layer-2 packet coding to various scenarios

9 – ZTE Corporation

We see the benefits of the network coding in terms of reliability and capacity improvement of multiple connections. For example, the legacy PDCP duplication has been specified in the scenario of dual-connection, selectivity diversity instead of combination diversity, which leads to insufficient usage of redundancy information and limited reliability performance. Therefore, we support the study of network coding in Rel-18. As for the objectives, we suggest the following as a starting point.

- Study the use cases and performance evaluation of PDCP duplication enhancement based on **network coding.**[RAN2]
- Study of protocol stacks of network coding based PDCP duplication, e.g., a network coding sub-layer between RLC layer and PDPC layer. [RAN2]
- Study erasure code schemes for network coding [RAN2]

– Study the potential erasure codes, e.g., Reed-Solomon codes, Raptor codes, LDGM codes for the potential use cases, and strive to derive a tradoff solution between performance and complexity.

10 – AT&T GNS Belgium SPRL

We support enablement of network coding functionality at the same layer as packet duplication (PDCP) in order to more efficiently support traffic types such as XR, which may require high data rates in combination with high reliability. Use of network coding at the PDCP layer residing at the CU-UP can significantly help to reduce such inefficiency caused due to data duplication over multiple legs. The use of outer codes, such as rateless fountain codes, can allow 'spraying' of encoded packets across more than one transmission leg, to enable successful reception while receiving only a subset of the transmitted packets. Leverage packet duplication feature specified in Rel-16 with up to 4 RLC entities (4-way CA or CA+DC combination). Applicability to URLLC and IAB, especially in a multi-frequency CA/DC scenario.

3 Intermediate Round

Based on the input in the initial round, a summary and a potential set of areas/objectives (except where stated otherwise) has been provided for each of the topics in the following sub-sections. Further views are invited on these potential set of areas/objectives in case a WI/SI is included in Rel-18 for the respective topic.

3.1 UAV (Unmanned Aerial Vehicle)

There seems to be strong support for a WI on Unmanned Aerial Vehicles (UAV) with many companies highlighting very similar areas/objectives. Multiple companies also expressed that the work should use the work done for LTE as the baseline. Some other companies expressed interest in optimizations for NR particularly addressing beam management. Based on the input in the initial round, the areas/objectives that have broad support are as follows.

- Measurement reports (RAN2)
  - UE-triggered measurement report based on configured height thresholds
  - Reporting of height, location and speed in measurement reports
  - Flight path reporting
- Signaling to support subscription-based aerial-UE identification (RAN2/RAN3/SA2 interaction)
- RRM enhancements to control volume of reports (RAN2)
- Mobility enhancements, e.g., for CHO
- Support for broadcast/groupcast of drone identification over PC5 (RAN2)
- Note: Work done in LTE is a starting point

Feedback is requested on the above list of areas/objectives for a potential UAV WI as well as on any aspects that may have been missed. General views on the topic can also be provided.

Feedback Form 8: Feedback on areas/objectives on UAV

1 – AT&T GNS Belgium SPRL

We agree with the proposed areas/objectives

2 – Classon Consulting

For FUTUREWEI

The item is too large, and unnecessarily encourages different solutions for NR than LTE. A first objective should be clearly written to migrate UAV features in LTE to NR, with subbullets for those features. Then, perhaps, a study and then specify objective for FCC support can be included. Other aspects (CHO, etc) need not be included.

3 – InterDigital

Support all above objectives. We note that Rel-17 NR NTN has discussed a number of these enhancements e.g. location-triggered measurement reporting, additional CHO triggers etc. We suggest considering the framework defined there as baseline, and adopting as necessary to fit specifics of UAVs.

4 – Apple Italia S.R.L.

We are generally neutral on the WI. But we prefer that any enhancements beyond what has been done in LTE are studied first before specification work.

5 – Verizon UK Ltd

We agree with the areas/objectives proposed by the moderator. Thank you

6 – Guangdong OPPO Mobile Telecom.

We think the current scope is a bit large and prefer to reuse the LTE UAV WID as the starting point.

7 – ZTE Corporation

The proposed objectives are general fine to me. However, for NR based UAV, we still prefer to consider more advanced features which will introduce significant performance comparing to the implementation based solution. In our view, the main momentum for NR based UAV is to enable the stable service for UAV with better throughput and supports for platoon communication is also critical. Then, we prefer to add the bullet on beam management part and power control for sidelink related discussion with RAN1 impacts.

8 – HUAWEI TECHNOLOGIES Co. Ltd.

Huawei, HiSilicon The proposed scope covers the copy and paste operation form LTE UAV + the new requirements on ID broadcasting (from FAA). We think that those should be the objectives of a possible WI in this area. As for other enhancements, we noticed that there is a good support for CHO and mobility enhancements, but at the same time these are not essential for the feature to work or to fulfill regulatory requirements. So we think that one way to reflect this would be to indicate that CHO and mobility enhancements are a secondary priority. Would can disagree with this statement?

9 – China Mobile Group Device Co.

Agree with the areas/objectives provided above.

10 – Qualcomm Incorporated

While we agree with the enhancements listed by the moderator, we think we should go a bit beyond the current set of objectives and include some aspects with minimal impact in RAN1:

- For remote identification, one of the FAA requirements is to achieve a range as large as possible. Current sidelink was not designed with long range communications as a focus, so RAN1 should specify enhancements to achieve longer range communications for UAVs flying in the air. Also, although remote ID may be one of the main use cases, we should not preclude applying sidelink to other scenarios (e.g. detect and avoid, similar to basic safety in LTE).
- As concluded in the LTE study, one of the major issues when supporting UAVs is the amount of interference they introduce to the system. If we envision UAVs being widely deployed in the next few years, we should also consider techniques to increase capacity and reduce operator's burden. Along this line, we propose to introduce necessary changes to support bands with a primary allocation to UAV communications (as being currently discussed by the FCC) which will alleviate the interference issues of sharing the spectrum with terrestrial UEs, and support for beamforming / directional antennas in FR1, which greatly improves the capacity due to reduced interference.

Other low hanging fruits such as aligning LTE specs to enable UAV support by ng-eNB could be considered without much additional workload in RAN2.

Therefore, we propose to add the following areas/objectives:

- Measurement reports (RAN2)
  - UE-triggered measurement report based on configured height thresholds
  - Reporting of height, location and speed in measurement reports
  - Flight path reporting
- Signaling to support subscription-based aerial-UE identification (RAN2/RAN3/SA2 interaction)
- RRM enhancements to control volume of reports (RAN2)
- Mobility enhancements, e.g., for CHO
- Enhanced beamforming / beam management for FR1 (RAN1)
- Support use-cases on band(s) allocated primarily for UAS operations (RAN4/RAN2)
- Support for broadcast/groupcast of drone identification and DAA over PC5 (RAN2, RAN1)
  - Adapt to UAV scenarios, such as 3D zone, UAV-specific assistance info, support of larger range communications

Note: Work done in LTE is a starting point

11 – Samsung Electronics Co.

We agree with the areas/objectives proposed by the moderator.

12 – vivo Mobile Communication Co.

We think the above scope is too large, the below three bullets from LTE can be considered in the first release.

Measurement reports (RAN2)

UE-triggered measurement report based on configured height thresholds

Reporting of height, location and speed in measurement reports

Flight path reporting

Signaling to support subscription-based aerial-UE identification (RAN2/RAN3/SA2 interaction)

RRM enhancements to control volume of reports (RAN2)

We do not think other mobility e.g., for CHO is needed in R18. It can be addressed in next release if necessary. Broadcast/groupcast of drone identification over PC5 is not essential, if ID is needed unicast can be used without RAN impact.

13 – Ericsson LM

We also agree with the objectives. A clarification is that the following bullet should be done not only for NR, but also for LTE to make sure that LTE also can comply with the regulations:

- Support for broadcast/groupcast of drone identification over PC5 (RAN2)

14 – Telia Company AB

Telia Company agrees with proposed objectives by the moderator.

15 – Lenovo Mobile Com. Technology

Thanks for the summary and draft objectives! We support all list objectives, and we also have some additional comments:

1. Besides listed objectives, we think beam management aspect can be studied for UAV since beam management is a specific aspect for NR system which can effectively reduce the interference caused by UAV

2. For bullet 3, a clarification question: does the purpose of this bullet to reuse multi-cell triggered measurement report from LTE UAV features?

3. For objectives structure, we understand for bullet 1 (measurement report), three sub-bullets are actually for different purpose, so we think restructure this bullet could be better. For example, sub-bullet 2, 3 are for mobility enhancement, which could be combined with bullet 4. And sub-bullet 1 is for RRM which could be combined with bullet 3

16 – VODAFONE Group Plc

We support work on UAV but do expect that the proposed scope is too large for Rel 18 -> the Huawei proposal may be a good way forward.

17 – Intel Corporation (UK) Ltd

We have comments on the following objectives.

- "RRM enhancements to control volume of repots" – The majority of companies support that LTE can be a starting point. However, it seems one feature introduced in LTE is missed in the above list although it is actually introduced to enhance RRM to control volume of measurement reports. From our pov, given that RAN2 comprehensively discussed on RRM enhancement to control volume of measurement reports during LTE WI phase, it is not necessary to have the same discussion in NR again given that the measurement framework is similar. Even if the companies really want to discuss again, it would be desirable to assume LTE feature as a baseline and to discuss new solution/aspect in NR. In conclusion, we suggest to add the following LTE feature in the list for this objective; "measurement reporting based on a configured number of cells (i.e. larger than one) fulfills the triggering criteria simultaneously.

- Mobility enhancements, e.g. for CHO : we are ok but given that location/timer based CHO is already agreed in Rel-17 NTN, we wonder if further enhancement is needed for UAV. We could check if there is any issue/gap in using Rel-17 NTN CHO to UAV.
- Support for broadcast/groupcast of drone identification over PC5: since it is under discussion in SA2 as a part of Rel-18 SI, RAN can wait for SA2 conclusion.

18 – BT plc

We support the areas / objectives proposed by the moderator.

19 – Nokia Corporation

In general we support the mentioned objectives, the specific area we would still see interesting additionally would be:

- Enhancements for increased connection reliability
- Enhancements for co-existence for high uplink aerial throughput (so a drone above stadium would not pollute too much all the sites below it)

3.2 IIOT (Industrial Internet of Things)/URLLC (Ultra-Reliable Low-Latency Communication)

A very diverse set of proposals were made without wide support for most, if not any, of them. Multiple companies also believe that a separate URLLC/IIOT WI is not justified in Rel-18 and many aspects can be handled as part of other WIs. Given this situation, it is difficult to envision a set of areas/objectives that can reach consensus for a potential WI in Rel-18.

Nevertheless, the moderator has tried to compile a list of all the proposals made. This is NOT a proposed list for a potential WI. Instead it is hoped that having all the proposals in this list form can facilitate a further short listing of areas/objectives in the intermediate round. Therefore, further views are invited to check if any of the proposals can garner wide enough support so that we can identify some potential areas in the final round in case there is a dedicated URLLC/IIOT WI in Rel-18.

The high level list of the areas/objectives proposed by companies is given below (NOT a list of objectives proposed by the moderator). The moderator may have missed some aspects or duplicated some areas. It is hoped that the feedback in the intermediate round can be used to address this as well.

- URLLC in INACTIVE mode
- URLLC with high data rates, e.g., for XR, factory automation etc.
- NR-U enhancements
  - URLLC operation in LBE and FBE considering LBT.
  - Enhancements to initial access and operation in wideband carriers.
  - Further enhancements of prioritization considering LBT failures.
- Leftovers from Rel-17
  - CSI feedback enhancements

    - SPS HARQ-ACK skipping and size reduction
    - Remaining intra-UE multiplexing and prioritization issues
    - Remaining propagation delay compensation enhancements
    - Enhanced Type-B repetition over multi-TTI PUSCH grants
    - Simultaneous PUSCH/PUCCH, PUCCH/PUCCH
- Real-time multiple UE back up (also discussed in ”others”)
- CG/SPS enhancements (some companies think it can be included in XR WI) (RAN1/2)
    - Dynamic free up of configured resources
    - Flexible multi-slot allocation (per TB MCS and per TB repetition)
- URLLC profile definition in 3GPP to identify essential features and enable reduced complexity URLLC devices for IIoT application [RAN1/RAN2]
- Sidelink URLLC enhancements for IIOT use cases
    - Direct sidelink communication for various IIoT use cases by enhancing physical layer reliability and latency of sidelink control/data channel communications
    - Sidelink based time sensitive networking and its potential impact on 3GPP architecture in collaboration with 3GPP SA WG2
- FR2 improvement for URLLC/IoT deployments including CA operation, beam management, greater number of TRPs
    - CA enhancements
    - Beam management
    - Greater number of TRPs
- Sync resiliency in case of RLF
- DL control efficiency
    - CSI feedback for PDCCH
    - Aggregation levels
    - Group scheduling
- Enhancements to scheduling & HARQ to address e.g., out-of-order HARQ, tighter processing time, as well as survival time aware scheduling enhancements
- UE based PDCP duplication activation/deactivation
- Cross-carrier operations for TDD with different UL/DL configurations
    - Flexible HARQ retransmission
    - PUCCH repetitions over multiple carriers
    - DG PUSCH/PDSCH repetitions over multiple carriers
    - Multiple CG/SPS configurations over multiple carriers
- Enhanced header/data compression with padding removal
- High UL throughput in TDD, e.g., enhancements to UL-DL split

- Identification of mission critical (MC) UEs/services using an early indication in Msg1 and/or MsgA PRACH
- Functionality and configurations to prioritize reliability/coverage enhancement of transmissions from MC UEs compared to normal UEs
- Functionality and mechanisms for finer priority-level differentiation between different MC UE groups or a finer differentiation granularity for MC services in initial access
- Methods for multiplexing/duplication of URLLC traffic with eMBB in case of M-TRP or for different PUSCHs
    - RLC duplication per TRP/PUSCH or LCH restrictions per TRP/PUSCH to work with PDCP duplication)
- Additional TSN assistance information to RAN for more efficient scheduling (RAN2/3, SA2)
- RRM Measurement enhancements to reduce latency due to measurement gap

Companies are invited to provide further feedback on which objectives/areas are important for a potential WI from the above. It is highly encouraged to provide a very small set of high priority items.

Feedback Form 9: Feedback on IIOT/URLLC to select a shorter list of high priority proposals with potentially wider support

1 – Classon Consulting

For FUTUREWEI

At the moment we are not inclined to support any URLLC specific enhancements in URLLC in Rel-18. XR enhancements can be considered in XR or MIMO. The only worthwhile CSI leftover would be the statistical approaches that had the largest evaluated gains in Rel-17.

2 – InterDigital

In general we agree that many of these proposals could be addressed in other SIs/WIs whereby it should be explicitly stated in those other SIs/Wis that solutions should achieve URLLC requirements.

Proposals that could be handled in other SIs/Wis include:

- URLLC in INACTIVE mode (Small Data)
- URLLC with high data rates (XR)
- CG/SPS enhancements (XR)
- Sidelink URLLC (Sidelink)
- Multiple terminal UE backup (Network coding or Collaborative UEs)

However, some proposals should be handled in a URLLC specific WI. These include:

- Rel-17 leftovers (including CSI feedback enhancements, SPS HARQ-ACK skipping and size reduction, remaining intra-UE multiplexing and prioritization issues, remaining propagation delay compensation enhancements, enhanced Type-B repetition over multi-TTI PUSCH grants, UE-based PDCP activation/deactivation)

- NR-U enhancements. To ensure URLLC requirements are met for both LBE and FBE when LBT may fail.
- CSI feedback for PDCCH
- FR2 enhancements for URLLC.

3 – Samsung Research America

Very much appreciate the moderator's effort in compiling an indeed diverse set of proposals. A broader assessment can be for (a) proposals related to other verticals (e.g. SL, NR-U, XR, RedCap), (b) new enhancements or previously proposed enhancements that were not considered due to scoping or time issues, and (c) enhancements that have been considered but not agreed. Clearly, (c) should not be pursued in Rel-18 - it cannot be a re-run of Rel-17. The same applies with (a) as, if necessary, URLLC KPIs can be part of other WIs - nevertheless, we could not identify any near term market need for enhancing URLLC operation for shared spectrum or for introducing the combined set of URLLC KPIs on SL. For the standalone enhancements of (b) we have been proponents of several ones in Rel-16/17 and support consideration of some new ones but it is hard to make the case for a new URLLC WI as it is difficult to justify most enhancements as "core" ones. It is preferable to consider possible inclusion of individual enhancements in applicable Rel-18 SIs/WIs (e.g. UL enhancements/MIMO, XR, RedCap, CA, ...).

4 – Apple Italia S.R.L.

In our view, CG/SPS enhancements is a high priority item, but this is better to be discussed in XR WI.

Leftover from Rel-17 is still not clear at this point, and it may be discussed later.

At this time, we do not see a very strong need for a separate IIoT/URLLC work item.

5 – Qualcomm Incorporated

From the moderator's summary it should be clear that it will be very hard to conclude on a reasonable set of objectives for Rel-18. Also, some of the enhancements have been already discussed in Rel-16/17 without a clear conclusion (e.g. intra-UE multiplexing).

Given the current situation, we would like to focus only on sidelink topics for Rel-18, since these have not been discussed before – we already had 2 releases of enhancements for Uu.

6 – LG Electronics Inc.

Many of the proposals are already suggested in other items or still under discussion in Rel-17 IIOT, which needs more time to see whether further work in Rel-18 is necessary or not. In our view, following items can be discussed in other items:

- URLLC in INACTIVE mode : SDT
- URLLC with high data rates : XR
- CG/SPS enhancement : XR
- Sidelink URLLC : Sidelink

If we have Rel-18 IIOT WI, we need to carefully set the direction of IIOT enhancement in Rel-18 so that different technology enhancement can be targeted compared to other similar items such as XR. For example, we can focus on URLLC service on personal device in XR WI while focusing on URLLC service on industry/factory area in Rel-18 IIOT. In this regards, we think real-time multiple UE backup can be considered as a scope of Rel-18 IIOT because it tries to solve a resource inefficiency of real mechanism that can be implemented for support of URLLC/IIOT in industry.

7 – LG Electronics Inc.

(Continued from the previous response)

From L1 perspective, we can consider to enhance scheduling & HARQ operation for URLLC, such as relaxation of the out-of-order HARQ constraint since current scheduling/HARQ operation could be a bottleneck to support URLLC/IIOT traffics, which have various requirements (e.g., latency, scheduling/HARQ delay, etc.). Regarding the left-over items from Rel-17 IIOT discussion, we think following items can be discussed for Rel-18 IIOT.

- SPS HARQ-ACK skipping and size reduction

- Remaining intra-UE multiplexing issues (if any)

8 – vivo Mobile Communication Co.

1 We agree with other companies' comments, most URLLC cases have been addressed in R16 and R17. Some small enhancements can be separated to other WI, e.g. XR.

2 For UE back-up case, we think it can be discussed with UE aggregation together, because both them belong collaborative UEs and have similar CP UP architecture in RAN.

9 – Motorola Mobility España SA

Lenovo/Motorola Mobility

High priority – Sidelink IIoT/URLLC

Atleast 6 companies (Qualcomm, Intel, Nokia, Spreadtrum, Sony, Lenovo/Motorola Mobility) support studying sidelink enhancement for IIoT/URLLC.

Sidelink IIoT/URLLC should be separately studied from that of general sidelink enhancement and relay as it addresses different industry needs. We agree with Qualcomm that IIoT/URLLC for Uu interface is well established and proved from the simulation exercise (RP-210490). We should provide the IIoT/URLLC ecosystem with both Uu and Sidelink deployment options as exist in V2X so that vertical partners can choose the right deployment options based on their needs thereby increasing the adoption rate of the 5G wireless devices in factory floors.

High priority - URLLC profile definition in 3GPP to identify essential features and enable reduced complexity URLLC devices for IIoT application.

Medium priority – NR-U enhancement supporting URLLC operation in LBE and FBE considering LBT

High priority – Study on the FR2 improvement for URLLC/IoT deployment

this work should be merged with XR work item to avoid duplication.

10 – ZTE Corporation

Thanks for moderator's effort to organize the discussion.

We share the most of views with InterDigital.

1) Generally we agree with that the high data rate with the simultaneous requirements of latency and reliability could be covered by XR WI. But with our observation on XR WI discussion, the most interest of XR discussion is not focusing on the FR2 enhancement. Then, in URLLC enhancement, we can further enhance on FR2/FR1 CA/DC focusing on improving FR2 PDSCH/PUSCH/PDCCH/PUCCH reliability

using FR1 as 'anchor carrier', to avoid scheduling unavailability due to e.g. measurement gaps or beam blockage.

2) Further we would like to further clarify the key topics suitable for URLLC on latency reduction, i.e., flexible cross-frequency transmission for TDD, including the following aspects:

- Flexible HARQ retransmission over multiple carriers (cross carriers HARQ)
- PUCCH repetition over multiple carriers
- DG PUSCH/PDSCH repetition over multiple carriers
- Multiple CG/SPS configurations over multiple carriers

Transmission switched from one CC to another CC is under specified in PHY Layer only for PUCCH, but data channels are more important and should benefit from the carrier/cell switching. It is necessary to enhance the overall URLLC performance.

The principle and motivation are similar with PUCCH carrier switching in Rel-17 scope. Just the carrier/cell switching is applied to the HARQ operation, the PUCCH repetitions, DG PUSCH/PDSCH repetition and CG/SPS transmission. Moreover, if cross carrier CG/SPS is allowed, the number of multiple CG/SPS configurations could be reduced and resource utilization efficiency can be improved.

This feature can be supported to make a new Rel-18 work item and can easily be justified as the core function of the new WI.

3) RRM measurement enhancement to reduce the transmission latency due to the measurement gap could also be considered as a topic of Rel-18 URLLC as the transmission interrupt due to measurement negatively affect the URLLC performance.

11 – Guangdong OPPO Mobile Telecom.

Thanks for moderator's effort in compiling the diverse proposals.

In our understanding, the following proposals can be merged by other SIs/WIs:

- URLLC with high data rates (XR)
- CG/SPS enhancements (XR)
- Real-time multiple UE back up(?)
- Sidelink URLLC enhancements for IIOT use cases(?)
- FR2 improvement for URLLC/IoT deployments including CA operation, beam management, greater number of TRPs(DCCA or MIMO)
- Cross-carrier operations for TDD with different UL/DL configurations(?)

For the following proposals, we are fine to discuss it either in R18 IIoT or XR, since they are benefit to traffic requirement of either one.

- R17 leftovers, especially for SPS HARQ-ACK skipping and compression, enhanced Type B repetition over Multi-TTI PUSCH grants
- Enhancements to scheduling and HARQ

12 – Siemens AG

Our focus is on topics further improving performance of URLLC and IIoT (for IIoT especially improvements to time synchronization accuracy) and Sidelink URLLC / time sync enhancements for IIoT.

We would like to see the following topics:

− URLLC with high data rates (for IIoT/industrial automation with increased data)

− High UL throughput in TDD, e.g., enhancements to UL-DL split

− Leftovers from Rel-17: Remaining propagation delay compensation enhancements

− Sidelink URLLC enhancements for IIoT use cases

○ Direct sidelink communication for various IIoT use cases by enhancing physical layer reliability and latency of sidelink control/data channel communications

○ Sidelink based time synchronization and time sensitive networking and its potential impact on 3GPP architecture in collaboration with 3GPP SA WG2

− FR2 improvement for URLLC/IIoT deployments

Further topics may be:

− Methods for multiplexing/duplication of URLLC traffic with eMBB

- Flexible multi-slot allocation

− Group scheduling for DL control efficiency

We are open to both, a separate URLLC/IIoT WI or to handle the topics in other SIs/WIs. In the latter case, it should be explicitely stated that solutions should achieve URLLC and IIoT in industrial automation deployments.

13 – VODAFONE Group Plc

At the moment we agree with Futurewei.

14 – MediaTek Inc.

In our view, the focus in R18 URLLC/IIoT WI should be on enhancing the system capacity. The system capacity for latency critical services is very limited. There were some enhancements in R16 and R17, but further enhancements (with limited focus) can be considered in R18. Below are the main suggested direction for the work:

- Leftovers from R17 should NOT be considered. These features had marginal system gain, hence they were not agreed in R17. No need to waste RAN1/RAN2 time again on re-discussing these issues.
- Focus on enhancements with high capacity gains (e.g. FR2, CA operation)
- Consider enhancements to DL control channel because it was not properly addressed in R16/R17.
- Side-link enhancements should be considered part of the SL WI.

15 – TELECOM ITALIA S.p.A.

Since it appears there are no available URLLC devices, it would be better to not further improve the features in order to allow market take up.

To ease that, the work could focus on URLLC profile definition in 3GPP to identify essential features and enable reduced complexity URLLC devices for IIoT application [RAN1/RAN2]

16 – Intel Corporation (UK) Ltd

We think it is useful to have a dedicated URLLC WI for Rel-18 since URLLC is an important vertical in NR and there is broad interest to further enhance URLLC.

Following are our preferences for focus areas which have relatively wide support:

- NR-U enhancements: this is a natural continuation of Rel-17 work.
- Sidelink URLLC enhancements for IIoT use cases: as IIoT work is focused on Uu until Rel-17, we see the support of IIoT / TSC use cases in sidelink an important step to enhance the URLLC vertical. Regarding comment that the work can be handled in sidelink WI, we consider that at this stage in the discussion it is much more important to focus on agreeing the technical areas that should be worked on, and the WI in which any technical area is placed can be concluded at a later stage of discussion. For now, we think that this IIoT/URLLC topic area is a suitable place to have the discussion.
- Cross-carrier operations for HARQ retransmission and repetition including multi-TRP aspects.
- SPS/CG enhancements: we observe interest to further enhancements for SPS/CG at least for capacity, latency, reliability, non-zero survival time. It can be decided later which item XR or URLLC can cover this objective.

17 – China Mobile Com. Corporation

From our perspective, the item of "Real-time multiple UE back up" can be prioritized and deserve to be studied in R18, since the motivation and necessity is clear and solid. Although NR URLLC was introduced in Release 15 and NR URLLC is further enhanced in Release 16 and Release 17, however, either RAN or the UE always aims to target the high reliability by transmitting duplication data through multiple radio links to the target side simultaneously. Obviously, it face the challenge of meeting the high reliability only relying on the reliability of one terminal. Meanwhile, duplication transmission is not resource-efficient in air interface for network capability. Moreover, the characteristics of fast failure detection and low latency and seamless taking over can ensure the feasibility and robustness of the mechanism. Furthermore, the objective of this Item should include the following bullets:

· To study the use cases and benefits of real-time multiple-UE backup, to study necessary procedures and/or information to support for real-time multiple-UE backup of data/signalling delivery and reception (e.g. how a given UE to determine whether to take over or start the data/signalling transmitted/received by associated UE for backup) without data disorder or data duplication

· To identify required specification changes on the group scheduling options to allow multiple UEs to receive signalling/data in Multicast mode

· To study the support for basic mobility with service continuity.

18 – CATT

From our perspective, we think the techniques targeting for URLLC with high data rates can be included in XR. Real-time multiple UE back up can be considered in Rel-18 since it was not considered in previous releases. Other than that, we do not see a strong need/urgency for other enhancements in Rel-18.

19 – Ericsson LM

For URLLC/IIoT, based on the initial discussions, we observe the following:

Majority of the areas/objectives proposed by companies can be addressed in other SIs/WIs, e.g.

- FR2 enhancements in MIMO

- CG/SPS enhancements, broadband URLLC and scheduling enhancements in general can be addressed in XR

- Sidelink enhancements for URLLC cannot be treated in URLLC working item. Discussion on whether to include it or not should be held in SL. In principle, we do not see a need to enhance SL for URLLC.

Many topics have been discussed or partially discussed without consensus among companies, e.g.

- CSI feedback for PDCCH, new aggregation levels

- UE based PDCP duplication (discussion is ongoing in RAN2 Rel17) and survival time considerations in general

- Out of order HARQ, tighter processing times - nice to have but too little support.

- NR-U enhancements for URLLC in LBE mode are not justified and were not included in scope of R17. Enhancements for FBE mode are under discussion of R17.

On Rel-17 leftovers, the discussion at this stage seems to be premature due to dependency to the outcome of Rel-17.

For mission critical communications, based on the initial discussions, our view is as the following:

Based on the current email discussions, **we don't think our proposals for mission critical communications fit into the section IIOT/URLLC. As these proposed enhancements are small, we think a better solution is to address them in a TEL.**

We think it is important to further enhance 5G access control and random access to enable early identification and finer priority-level differentiation of mission critical users/services compared to other users/services. These enhancements are needed for a 5G network to make an early decision on prioritizing mission critical UEs/services, ensure the flow of mission critical traffic in high load situations, gain time for pre-empting low-priority traffic if need, and avoid unnecessary network processing or delay caused by info exchange between DU, CU-CP, and CN.

Therefore, the following objectives should be considered in NR Rel-18 development for mission critical use cases:

- Specify functionality and configurations that will enable networks to identify MC UEs/services using an early indication in Msg1 and/or MsgA PRACH. [RAN2, RAN1]
  - Differentiated PRACH configuration (e.g., PRACH occasions, preamble indexes, etc.) for MC UEs/services and other UEs/services
  - RAR configuration for MC UEs/services (e.g., new RA-RNTIs, new CORESET or/and common search space for Msg2/MsgB)
- Specify functionality and configurations to prioritize reliability/coverage enhancement of transmissions from MC UEs compared to normal UEs [RAN1, RAN2] such as
  - Repetition or using a higher transmit power for Msg1/Msg3/MsgA transmissions from MC UEs
  - Inclusion of an early CSI report from MC UEs in initial access
- Specify functionality and mechanisms to support finer priority-level differentiation between different MC UE groups or a finer differentiation granularity for MC services in initial access [SA1, RAN2]
  - Introduce new access identities for different MC UE groups or service groups
  - Define new rules on mapping the newly introduced access identities to RRC establishment causes

20 – HUAWEI TECHNOLOGIES Co. Ltd.

It is true that the potential areas proposed by companies for Rel-18 URLLC/IIoT are diverse. On the one hand, we agree that some of the potential areas may be more appropriate for other SIs/WIs, e.g. URLLC in INACTIVE mode, URLLC with high data rates, Sidelink for URLLC. On the other hand, we also see some of the areas in the list is more appropriate in a dedicate URLLC WI. From our side, at least the following are worthwhile to set up a URLLC specific WI.

- Cross-carrier operations for TDD with different UL/DL configurations, at least including flexible HARQ retransmission
- FR2 improvement for URLLC/IoT deployments, at least including beam management and greater number of TRPs
- Enhancement for equipment reliability, including UE backup
- Rel-17 leftovers, e.g., SPS HARQ-ACK skipping, CSI enhancements, etc.

Some detailed explanation on the above three areas can be found below:

Area 1: Cross-carrier HARQ retransmission for TDD with different UL/DL configurations

According to the existing mechanism, the initial transmission and re-transmission for data needs to on the same serving cell, which will result in large latency for data transmission on a TDD cell. For TDD CA with different UL/DL configurations, enabling flexible initial transmission and re-transmission on different serving cells would largely reduce the latency. If we don't enable flexible HARQ retransmission, it may result in TDD difficult to meet the requirement for most of the URLLC scenarios, while TDD is the very typical spectrum for NR. Some detailed example on the gain can be found in our paper RWS-210442.

Area 2: FR2 enhancements for URLLC

Due to wide bandwidth of FR2, it is beneficial for URLLC from latency and reliability perspective. However, it is expected that the beam blockage will have large impact on reliability also, which will limit the applicability of FR2 for URLLC. Therefore, it is worthwhile to look for some potential enhancements to improve the reliability to meet URLLC requirement. For example, mechanisms to enable fast identification of beam/panel blocking, or support of larger number of TRPs for joint transmission/reception can be considered. It is true that there is FR2 enhancements in other WI/SI also, however they may not mainly target for URLLC with tight requirement and just do some general enhancements, which may not guarantee the tight URLLC requirement.

Area 3: Enhancement for equipment reliability

In industry IoT, redundancy of network and nodes are very important. Although the traditional UE backup scheme can improve UE reliability by duplicating traffic data to two UEs and transmitting by the two UEs, it is very resource-consuming, which will further reduce the already very limited URLLC capacity. Therefore, it is worthwhile to introduce some high-efficient UE backup mechanism to enhance equipment reliability. We don't see any relationship between UE backup and network coding, and it seems there is no any other appropriate WI/SI for it.

Area 4: Rel-17 left over

For left over from Rel-17 due to time limit, we think it is still worthwhile to re-consider in Rel-18.

21 – Sony Europe B.V.

Some of the proposed features, e.g. high throughput URLLC and enhanced UL:DL split in TDD can be absorbed into XR.

However, there are some left-overs, e.g. further CSI enhancements and Out-of-Order PUSCH/PDSCH that do belong to URLLC. One way is to see how many left-overs are there and decide whether to have a small WI on Rel-18 URLLC.

22 – Nokia Corporation

We are interested on the following among this list:

- FR2 URLLC

- URLLC UE profile (could be RAN level also)
- Synchronization aspects
- Multi-UE for URLLC

We also see that we should get the basic URLLC UE definition in place and not start now complicating the picture with involving sidelink here

23 – Nokia Corporation

Clarification for our comment above ”Multi-UE for URLLC” was referring to the ”Real-time multiple UE back up”

3.3 <5 MHz in Dedicated Spectrum

There is some support for addressing the railway, smart grid and public safety use cases. A desire is also expressed to limit this to dedicated spectrum and that it should not spill over into commercial bands. If a WI is to be supported in Rel-18 for this, the following could be potential focus areas/objectives.

- 3-5 MHz in dedicated FDD FR1 spectrum (RAN1)
  - SCS: 15 kHz
  - SSB: PSS/SSS without puncturing, reuse PBCH with puncturing
  - PDCCH: No new CORESET#0 size
  - CSI-RS/TRS with flexible bandwidth
  - PRACH format restriction with UL BW < 5 MHz
  - PUCCH changes without affecting performance
- Changes to support deploying NR (RAN4)
  - System parameters including channel and sync rasters
  - RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS)
  - RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS)

Companies are invited to provide further feedback on the above list of areas/objectives during the intermediate round.

Feedback Form 10: Feedback on potential list of areas/objectives for <5 MHz BW in dedicated spectrum

1 – InterDigital

We support the proposal.

2 – Apple Italia S.R.L.

We are generally neutral on whether to include the WI in R18.

If it is to be included, it is important to limit it to the dedicated spectrum and minimize the spec impact. The proposed RAN1 scope looks reasonable. For PUCCH, we would prefer some study first, e.g. like “study

of PUCCH enhancements targeting for no or minimum performance impact".

We hope to minimize the impact on UE RF and baseband requirements by reusing existing NR design as much as possible. In particular, RAN4 should explore to what extent the RF requirements and system parameters for NR 5MHz channel can be reused for smaller than 5MHz channels.

3 – Anterix

Anterix is encouraged by the consolidation presented by the moderator and support it. In general, we agree with the proposal outlined in section 3.3 which only a few minor considerations for clarity.

- In addition to 15 kHz SCS, the normal CP should be used.
- For RAN4 our goal is to minimize impact to existing RF requirements and specify/create new requirements for a 3 MHz BW primarily (similar to existing LTE) and if possible reuse 5 MHz requirements for FRMCS.
- In the RAN4 section there is a cut/pasted between "rastersRF", the portion after RF should be deleted.

Due to market pressures and regulatory agency requirements for Band n8 900 MHz networks, RMR-900 band, Band n26 allocations for SouthernLinc and PPDR allocations in Band n28 there is a real demand to deploy NR capable networks in the Rel-18 timeframe. As operators of this spectrum we have thoughtfully evaluated the tradeoffs of puncturing versus something new and how that effects the ecosystem. It should be noted these are constraints on overall system CBW and not on device capability. We hope to have a very large availability of device types operational in these bands.

4 – Qualcomm Incorporated

We agree with the Chairman's summary, which is a good convergence of objectives. In RAN1 part, it's better to add using normal CP (NCP) for clarification. In RAN4 part, the 'RF requirement…' is duplicated, which should be deleted. The part of specifying RF requirement of 3MHz BW is missing, which may need to be specified for the cases than FRMCS. So we suggest the following changes:

- − 3-5 MHz in dedicated FDD FR1 spectrum (RAN1)
  - SCS: 15 kHz
  - CP: NCP

…

- Changes to support deploying NR (RAN4)
  - System parameters including channel and sync rasters~~RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS)~~
  - RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS, and specify RF requirement of 3MHz BW for other cases)

5 – Nokia France

The moderator's summary is clear and reflects well the needs of the identified markets. As many companies have indicated, the specification impact should be kept to a minimum.

We agree with the updates from Qualcomm just above; the rationale for the additional text on the RAN4 part is to make it clear that in order to minimise the work, RF requirements for only one new channel bandwidth are proposed, namely for 3 MHz.

We would also suggest a slight rewording of the PUCCH point in line with the original proposals from ourselves, Anterix and Qualcomm, and as also indicated by Apple, to make it clear that only necessary changes would be considered:

”PUCCH changes without affecting performance, if existing design has limitations”

Regarding Rel-18/19, we are not sure whether it is supposed to be within scope of this discussion, but, as it has been raised, we feel it is worth highlighting that the FRMCS migration timescale points to a short Rel-18 work item being needed.

Regarding the comment from Huawei about RedCap, to eliminate any misunderstanding we would like to re-emphasise, as already stated, that this topic is quite distinct from RedCap. Here we address limited spectrum allocations, not limited device capabilities. If a device that can operate on one of these narrow spectrum allocations moves onto a normal NR carrier, it would operate as a normal NR UE.

6 – Samsung Electronics Co.

Discussion seems to be focused on determining the scope of this item for Rel-18 assuming that it is introduced. Then, we need to clarify on the last bullet on the first main bullet, i.e., PUCCH changes without affecting performance: 1) First of all, we don’t see the necessity of PUCCH enhancement. We would like to clarify which aspect needs to be changed 2) There are many PUCCH formats in NR. We would like to clarify whether the PUCCH change is intended for all PUCCH formats supported in NR or it is limited to a particular format. Based on these uncertainties, we put ’if needed’ at the end of sentence in the last bullet as:

- 3 - 5 MHz in dedicated FDD FR1 spectrum (RAN1)

  - ...
  - PUCCH changes without affecting performance, if needed

7 – vivo Communication Technology

Some link level performance impact caused by narrow bandwidth due to less frequency diversity will be expected. If this is an isssue, it applies to all the DL and UL channels. We are wondering why PUCCH is treated specifcially here to compensate the performance impact?

8 – ZTE Corporation

In principle, we are fine with the some objectives, however we also have comments for the rest and needs further clarification as following:

For RAN1 part:

For PBCH, we think that PBCH performance degradation should be minimized to ensure the coverage regardless using schemes of PBCH with puncturing or PBCH with remapping;

For PDCCH, it’s not clear for us on intention of No new CORESET#0 size since the minimum CORESET#0 size is assumed 24 which cannot fit into narrow bandwidth proposed here.

For CSI-RS with flexible banwidth, it’s not clear what’s flexible bandwidth here and its usage.

For PUCCH, not sure the intention with PUCCH changes since the impacts of frequency hopping on PUCCH due to narrow bandwidth is unknown yet, it might be not clear what we can do next step.

For RAN4 part:

We think that clear band definition and potential CBW (e.g. 3.6MHz, 2.8MHz and 3MHz) for vertical industry is needed otherwise it’s not clear how to trigger the work in RAN4.

Based on the above considerations,we propose to have the following updates:

− 3-5 MHz in dedicated FDD FR1 spectrum (RAN1)

○ SCS: 15 kHz

○ SSB: PSS/SSS without puncturing, reuse PBCH with minimizing PBCH performance degradation~~with puncturing~~

○[PDCCH: No new CORESET#0 size]

○ [CSI-RS/TRS with flexible bandwidth]

○ PRACH format restriction with UL BW < 5 MHz

~~PUCCH changes without affecting performance~~

− Changes to support deploying NR (RAN4)

○ Band definition from vertical industry

○ System parameters including channel and sync rasters ~~RF~~ requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS)

○ RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS)

9 – Huawei Tech.(UK) Co.. Ltd

Thanks for the moderator's summary and proposal, if there is a SI/WI on this topic, the following comments are to moderator's proposals:

- For SSB, the bandwidth is 3.6 MHz, thus it is possible to be entirely deployed in <5MHz bandwidth. We think "reuse PBCH with puncturing" should be deleted.
- For PDCCH, if there is no new CORESET#0 size, it does not appear possible to deploy in bandwidths between 3-5 MHz. This constraint bullet can be removed, and left to RAN1 to decide detail solutions.
- For CSI-RS/TRS, we would appreciate more detail on what is meant by "flexibility", since the word can refer to various possibilities.
- For PUCCH, it is lacking justification why PUCCH needs change, and what is the potential change. If it can be clarified, then adding "if any" is needed to allow checking in RAN1.

A question to the moderator and proponents: is the intention that any NR UE (RedCap or non-RedCap) which supports such a dedicated band and this potential new feature can access the <5 MHz system, or would the WI limit access only to UEs with a <5 MHz bandwidth? It would be clearer to include what kind of UE is expected for this in the objectives.

10 – Swiss Federal Railways Ltd

UIC (International Union of the Railways)

Thanks for the good summary, which addresses the technical key points and, as a result, reflects a basic consensus. From the contributions it could be seen that the schedule for the provision of the solution tends to range between Rel-18 and Rel-19. At this point, UIC would like to emphasize that the envisaged solution should be available in its implementation as early as 2025. This is based on a broadly coordinated plan of the individual railway undertakings, infrastructure managers and the European Railway Agency (ERA) responsible for interoperability. Therefore, UIC assumes that the envisaged solution can be provided within 3GPP Rel-18 timeframe.

11 – MediaTek Inc.

We are neutral on this topic. However, if we decide to go ahead with a SI/WI on this topic in Rel-18, we have the following points:

- It is important to emphasize the point raised in the earlier round that this work should be limited to dedicated spectrum and should not spill over into commercial bands.
- The scope of the work should be limited to essential changes only. From that perspective, we agree with others that it is unclear what PUCCH changes are needed here, and would prefer the addition of 'if any' to this potential objective.

12 – Fraunhofer IIS

Multiple companies expressed their demand for 5G in limited dedicated spectrum. The discussion started in RedCap as a power efficiency feature. The use cases mentioned in the discussion so far seem to have no specific need for reduced complexity and therefore this should be studied outside of RedCap. We think a well defined study item at the start of Rel-18 should precede possible normative work to get a better idea about the issues and required changes.

13 – Swiss Federal Railways Ltd

UIC (International Union of the Railways)

RWS-210280 elaborates about that GSM-R and FRMCS have to share a spectrum of 2x5.6MHz for a period of time. Up to 14 GSM-R carriers (200kHz) can be used. This requires a certain flexibility in the envisaged solution to also enable a CBW of less than 3MHz. Therefore it is suggested to add the following "approx. 3MHz" as part of the objectives.

14 – Orange

We are supportive of the proposal and agree with Qualcomm that the scope should not just mention FRMCS. As presented in the introduction, other cases than FRMCS are considered, including the need for PPDR in Europe with a 2x3 MHz allocation in 700 MHz. We agree with Qualcomm's proposed revision.

3.4 Other IoT Enhancements/Types

In general the proposals were broadly in the categories of personal IoT and passive IoT with battery less devices. There was less support for personal IoT and more interest in passive IoT. A few companies don't think this is high priority for Rel-18. Some companies think we should focus on Wake-Up Radio (WUR) first which can be done in another WI/SI. If there is going to be some work in Rel-18, it is probably better to have a study with general objectives as listed below.

- Study of use cases and design targets for passive IoT for power consumption, complexity, link budget (RAN1/2/4, RAN)
- Identification of key areas to enhance to achieve design targets of passive IoT for power consumption, complexity, link budget (RAN1/2/4)

Companies are invited to provide further feedback on the above areas/objectives as well as any other general views on this topic.

Feedback Form 11: Feedback on other IoT enhancements/-types

1 – Classon Consulting

for FUTUREWEI We are supportive of the moderator proposed objectives. The upside of Passive IoT could be very large for 3GPP, and we need these sorts of impactful studies in our Rel-18 package.

2 – InterDigital

Low power radio should be studied with higher priority than passive IoT. However, we believe that low power radio could be handled in a separate SI/WI for Reduced Capabilities or Power Savings.

3 – Apple Italia S.R.L.

We think WUR should have higher priority than passive IoT.

4 – Intel Corporation (UK) Ltd

We are supportive of the moderator proposal. Initial studies to identify target KPIs and means to achieve them to support passive IoT and energy harvesting based devices for battery-less operations can be initiated in Rel-18 towards addressing this IoT vertical that has not yet been considered by 3GPP RAN.

5 – Samsung Research America

Overall we are not interested in having this study in Rel-18. Passive IoT can be of interest in a later Release.

6 – Qualcomm Incorporated

We agree with some of the comments in the previous round that, regarding WUR, we would rather study it under the umbrella of RedCap (including zero power). For the other enhancements regarding passive devices, although we are interested on them, we think the technology is not mature enough to justify a SI/WI at this stage (e.g. similar to RIS).

7 – Motorola Mobility France S.A.S

Lenovo/Motorola Mobility

We are supportive of the objectives proposed by the moderator. Given the commercial need and IoT trend, we should initiate in Rel-18 a study of the passive IoT use cases, targets and potential enhancements for power consumption, complexity/cost and coverage to achieve the targets.

8 – NTT DOCOMO INC.

As commented in the initial round, we are technically supportive of the moderator proposal, but don't see any urgency. This study can be considered as 2nd priority for Rel-18.

9 – ZTE Corporation

For passive IoT, if the scope is mainly about the use cases and design targets, we are wondering if this should be handled in RAN or SA first, given that there is a similar SA1 proposal on WPSC, i.e. S1-213046.

10 – Orange

Although we think Passive IoT is a promising topic for the future, we think that the technology is not mature enough to be studied in 3GPP in Rel-18.

11 – China Mobile Com. Corporation

(1) We see there is strong requirement from industrial customers for Passive IoT, e.g., Automotive industry, smart manufacture. We support to study Passive IoT. Considering on the comments from other companies, we think at least we can have a Study item in Rel-18. And the work item may be left to Rel-19.

The Passive IoT study item objectives proposed by moderator looks ok to us and can be taken as a starting point.

(2) Regarding to personal IoT, we think the study for Inter-UE Handover or Replication for Same User is relevant to this sub-agenda item as well. From our perspective, we see the following commonalities among the listed contribution in the table of the email discussion:

a. The intention is to require the network can enable the users to initiate, handover (transfer/ switch), or sometimes replicate communication streaming (e.g. video, speech, audio) between multiple devices of the same end-user for a variety of reasons, in order to make the inter-UE handover/replication more flexibility and improve radio resource efficiency via RAN-based solutions.

b. Study the control plane procedure design, including RRC connection management, paging mechanism and access control for initiating inter-UE handover and replication for the same end-user.

c. Study user plan functionalities that will support data forwarding/data replication of communication data amongst multiple devices of the same end-user, e.g. which layer to act as the anchor layer to perform the data forwarding/routing.

d. And we think the SA2 can be involved in the RAN study, but no need to wait for the ultimate result from SA.

12 – vivo Communication Technology

We see the need to study Passive IOT in Rel-18, we can start with use cases and the key design requirements, i.e. cost, power and coverage.

13 – Ericsson LM

Agree to support WUR, but this topic should be handled under the RedCap discussion and no further discussion needed here.

For passive IoT, we agree that it is too early to consider this already in Rel-18.

14 – China Telecommunications

Regarding the different between WUR and DL passive IoT, we think that wideband or narrowband transmission might be the main different between WUR and passive IoT downlink. WUR may pay more attention to the compatibility with existing NR scheme than performance optimization, while passive IoT may care more about performance optimization with the constraints of coexisting with NR/LTE. In that sense, considering the batteryless device or ultra-low power device without battery replacement during lifetime is the essential requirement in the near future, we support to conduct a specific study/work on this topic.

15 – Philips International B.V.

We agree with the moderator to initiate a SI in Rel-18 on passive IoT. This SI should be separate from the WI/SI that may be generated out of the UE power savings discussions

16 – Huawei Tech.(UK) Co.. Ltd

We support the moderator's proposal for a Rel-18 SI, because other technologies are actively seeking to occupy this market space now. If there is no indication from 3GPP that our technology is coming, the market may settle on other options in the too-near future, rendering it very difficult for 3GPP businesses to access that market later.

We support the separation between passive IoT and other low-power receivers, because the target use case and requirements are quite different, which means there is need to allow distinct discussion of what the key areas needing adaptations would be, without the relatively tighter linkage to the current NR air interface which would be implied by linking to a low-power wake-up receiver assumption.

17 – Spreadtrum Communications

For personal IOT, we share the similar views with CMCC that there are some commonalities we can study in this sub-agenda item

For Passive IoT, we also see the strong need from our vertical customers, and we prefer to have a feasibility study in Rel-18.

18 – MediaTek Inc.

Our understanding is that **the study is related to stage-1 requirements typically developed by SA1**. It will be useful if companies can provide the reference to stage-1 requirements for this RAN study; or **further coordination with SA may be needed for this potential area**.

19 – China Unicom

There are strong market demands from industrial customers for Passive IoT, which is different from personal IoT, RedCap, low power radio, etc. We propose to treat Passive IoT as a individual Rel-18 study item/work item. It is proposed to study use cases, targets KPI and potential enhancements for consumption, complexity/cost and link budget. From our view, WUR is related with RedCap, and WUR should be included in RedCap WI.

20 – CATT

We support the moderator's proposal for a Rel-18 study item on passive IoT. It would be helpful for 3GPP community to open the door of new market.

21 – Fraunhofer IIS

We agree with Intel on having an initial study for energy harvesting. Regarding "Passive IoT" it is not clear what exactly this is.

From our perspective, the discussion about WUR/WUS and Energy Harvesting is related and both features support each other.

Personal IoT networks is not a priority for us right now.

3.5 HAPS (High Altitude Platform System)

There was interest expressed in studying HAPS separately from the work on NTN by many companies. There were also views expressed by multiple companies that there is already support in Rel-17 and gaps should be identified first. Updating of TR to 38.821 to better address HAPS was also brought up. If there is going to be an SI, the objectives given below can be discussed further.

- Development of HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821.
  - Determination of HAPS scenario(s) (RAN1/4)
  - Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)
  - Mobility and interference study considering spectrum (RAN1/2)
  - Applicability of TDD from remote interference PoV (RAN1)
  - Applicability of regenerative and transparent payload (RAN2/3)
- Identification of problems of pre-Rel-18 specs under the developed HAPS scenario(s) and potential solutions (RAN1/2/3)
  - Co-channel interference avoidance/mitigation
  - Mobility and Beam management
  - Inter-HAPS link and/or HAPS radio interface
  - Coverage, throughput, overhead, latency and UE power consumption optimization

Further input is invited on the above areas/objectives, particularly on which of these are higher priority.

Feedback Form 12: Feedback on list of areas/objectives for HAPS

1 – AT&T GNS Belgium SPRL

We have concerns about supporting such a broad study for HAPS in Rel-18. Rel-17 already has significant functionality needed to support HAPS. 3GPP's time may be better spent leveraging common solutions across NTN and HAPS.

2 – InterDigital

We are in general supportive of the above areas of study. We think primary objectives should focus on aspects related to identification of HAPS deployment and configuration scenarios and study of co-existence with TN (e.g. co-channel interference avoidance/mitigation). Aspects such as mobility, beam management, and coverage/throughput/latency/power consumption can leverage existing solutions from NTN and should be considered as a second priority. However, based on eventual HAPS deployment definition, they may require some optimization. We think regenerative and inter-HAPS links should be excluded from study in initial release and can adopt solutions once defined in NR-NTN.

3 – Apple Italia S.R.L.

The proposed scope seems to be quite broad and general. If this is to be included in Rel-18, we would prefer that some initial gap analysis is done first to identify the difference between NTN and HAPS solutions, in order to have a more focused study. As one example, for inter-HAPS link, it is not clear to us whether the

consideration is different from inter-satellite link. From RAN4 perspective, if possible, we should aim to reuse the R17 NTN UE requirements, especially for handheld UEs, to minimize the UE implementation impact in order to support HAPS in addition to LEO/GEO satellites.

4 – Intelsat

We support the proposed scope for the HAPS SI. A few of the more important aspects include,

- Co-Existence study with other HAPS and/or TN
- Mobility and interference study
- And architectures including regenerative and transparent payloads. Methods which reduce weight and improve performance would be particularly important.

These issues are sufficiently particular to HAPS to warrant their investigation.

We also support the identification of problems for HAPS, beam management and inter-HAPS links in particular.

To the extent that there may be overlap with work done in NTN we believe this SI could focus on solutions specific to the unique characteristics of HAPS.

5 – SoftBank Corp.

Thank you very much for the moderator's proposal.

Regarding the concern from some companies, we are not so sure why they can predicate that there is not HAPS specific issues even though we have no common understanding on the definition of HAPS and HAPS scenarios. Solving the missing part in the TR is quite important as a first step for HAPS industry. Otherwise, HAPS is not visible at all from outside of 3GPP. This is one reason why HAPS SI/WI is needed in Rel-18.

In our understanding, the scope of this discussion is to clarify what needs to be done for HAPS. The discussion on whether or not separate vs unified WI/SI is the next step discussion. Thus, we think the moderator's proposal summarizes the companies preference very well, and we support it.

If further refinement is required to address the concerns from some companies, we can consider to modify the moderator's proposal as follows, given the second bullet point is the controversy. The intention is (1) to focus on the completion of TR, (2) to keep the commonality with satellite as much as possible, i.e. common issue will be handled in Rel-18 eNTN, and (3) to leave potential HAPS specific enhancements in the future, which allows companies to think about it more.

- Development of HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821.
  - Determination of HAPS scenario(s) (RAN1/4)
  - Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)
  - Mobility and interference study considering spectrum (RAN1/2)
  - Applicability of TDD from remote interference PoV (RAN1)
  - Applicability of regenerative and transparent payload (RAN2/3)
- ~~Identification of problems of pre-Rel-18 specs under the developed HAPS scenario(s) and potential solutions (RAN1/2/3)~~
  - ~~Co-channel interference avoidance/mitigation~~
  - ~~Mobility and Beam management~~

- ~~Inter-HAPS link and/or HAPS radio interface~~
- ~~Coverage, throughput, overhead, latency and UE power consumption optimization~~

- **Note: potential enhancements that is deemed to be common with satellite (e.g. Mobility and Beam management, Inter-HAPS link and/or HAPS radio interface, Coverage, throughput, overhead, latency and UE power consumption optimization) can be handled under NTN discussion. The developed HAPS scenarios and study above shall be considered.**

6 – Guangdong OPPO Mobile Telecom.

We agree with AT&T that HAPS-specific study should be considered as a lower priority in Rel-18, as most of R17 NTN solutions can implictly support HAPS. We should be careful to include this given the limited Rel-18 timeframe and lots of other interesting topics.

7 – ZTE Corporation

We are in general interested in this topic, but we should focus on the dedicated/essential part for HAPS, which is not supported by previous Rel-17 design, e.g., TDD issue. Within the proposed list, it's not justified to study the mobility and beam management part based on the legacy solution. Moreover, inter-HAPS is highly depending on the architecture for this node, and further consideration in later phase is more reasonable, especially the regenerative payload related discussion may be considered in NTN. For the performance enhancement related topic, we may need to reconsider it once the scenarios and needs are justified.

8 – KDDI Corporation

Regarding HAPS specific issues and common understanding on the definition of HAPS and HAPS scenarios, we fully agree with views that Softbank pointed out. In our understanding, those basic objectives have not yet been discussed in 3GPP, therefore we also propose to study and specify the definition and scenarios firstly.

Considering that time units might be spent on basic discussion like above our comments in SI phase, the Rel-18 SI objectives should be minimized anyway. And also, potential enhancements on mobility, interfaces having commonality with satellite seems to be very controversial topics, therefore we agree with Softbank's proposal that those enhancements can be discussed in Rel-17/18 NTN topics.

9 – Qualcomm Incorporated

Based on the provided input, although we do not see a high priority for this item, we could focus on trying to summarize the scenarios and potential gaps (in our understanding, it should be possible to already deploy basic HAPS functionality based on current specifications).

10 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility

We are in general supportive of the moderator proposal and strongly feel that all of the above-mentioned issues for HAPS need to be addressed. However, we also feel that the spectrum of study is very broad. In our point of view, we first need a clear picture/understanding of the deployment scenarios for HAPS and only based on that, we can identify the commonalities/differences between the solutions/procedures presented in TR 38.821. From our perspective, the above proposal can be confined to the study of deployment scenarios

and identification of the problem areas of pre-Rel-18 specs for these scenarios. Moreover, we can start with regenerative payload as a baseline for HAPS.

- Development of HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821

o Determination of HAPS scenario(s) (RAN1/4)

o Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)

o Mobility, **beam management** and interference study considering spectrum (RAN1/2)

o Applicability of TDD from remote interference PoV (RAN1)

o Applicability of regenerative and transparent payload (RAN2/3)

- Identification of problems of pre-Rel-18 specs under the developed HAPS scenario(s)

11 – Ericsson France S.A.S

Our understanding is that the necessary standard hooks for HAPS are present and optimizations for particular scenarios are proprietary to network implementations. So we do not believe that a separate study is needed. It may be useful to raise visibility of the HAPS coverage in the specifications, and this can be done within the framework of the NTN work.

12 – DOCOMO Communications Lab.

We have same view with Softbank. Without sufficient study for HAPS, why we can say that current NTN is fine for HAPS as well? At least SI for HAPS support is necessary.

On the scope, we are OK to remove the second bullet. However inter-HAPS link, which would be main motivation of regenerative payload, would be related to ”Determination of HAPS scenario(s)”. So the following update is suggested from our side.

- Development of HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821.
  - Determination of HAPS scenario(s) **including inter-HAPS link** (RAN1/4)
  - Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)
  - Mobility and interference study considering spectrum (RAN1/2)
  - Applicability of TDD from remote interference PoV (RAN1)
  - Applicability of regenerative and transparent payload (RAN2/3)
- ~~Identification of problems of pre-Rel-18 specs under the developed HAPS scenario(s) and potential solutions (RAN1/2/3)~~
  - ~~Co-channel interference avoidance/mitigation~~
  - ~~Mobility and Beam management~~
  - ~~Inter-HAPS link and/or HAPS radio interface~~
  - ~~Coverage, throughput, overhead, latency and UE power consumption optimization~~

13 – HUAWEI TECHNOLOGIES Co. Ltd.

From our view, it is reasonable to develop HAPS deployment and configuration scenarios and update/complete TR38.821 accordingly. Once the scenarios are clear, potential issues and solutions can be discussed and identified.

14 – VODAFONE Group Plc

While we suspect that Qualcomm and Ericsson are correct about the current system's ability to support HAPS, we think that it would be useful to have a limited study to verify this and document the conclusions.

15 – Samsung Electronics Co.

We think the scope of study is too broad and the following two aspects are enough.

> Determination of HAPS scenario(s) (RAN1/4)

> Co-ex study with other HAPS and/or TN/NTN (RAN4)

> Study on applicability of NTN to HAPS, and identify the issues (if any) (RAN1/2/3/4)

The regenerative payload should be discussed in Rel-18 eNTN first.

16 – Spreadtrum Communications

We are fine to discuss this topic in R18. HAPS deployment and configuration scenario(s) need to be identified firstly. Currrently, potential issues and solutions for HPAS is not clear.

17 – China Unicom

We strongly support HAPS SI/WI in R18. We think the scope of HAPS in R18 should at least include the below bullets:

- Study on inter-HAPS, HAPS and/or TN scenarios for both TDD and FDD.
- Study on mobility, beam management and interference (i.e. co-channel interference, adjacent channel interference).
- Study on architectures including regenerative and transparent payloads.

3.6 Network Coding

Some companies support studying network coding including based on enhancements of PDCP duplication. However, multiple companies have also expressed strong reservations. If there is study it can consider the following areas.

- Study of layer(s) on which network coding should be performed including study of protocol stacks of network coding based on PDCP duplication, e.g., network coding layer between RLC and PDCP (RAN2)
- Identification and evaluation of scenarios (e.g. URLLC, DC, IAB, etc.) where Layer-2 packet coding can be introduced with benefits including PDCP duplication enhancements based on network coding
- Identification of architecture and protocol impacts for applying Layer-2 packet coding to various scenarios.

Further views on the above areas/objectives as well as general views on the topic of network coding are invited in the intermediate round.

Feedback Form 13: Feedback on area/objectives as well as general views on network coding

1 – AT&T GNS Belgium SPRL

Agree with proposed areas/objectives

2 – InterDigital

We support the proposal.

3 – Apple Italia S.R.L.

Although the scenarios described are interesting, we agree with the companies expressing concern that the benefits and complexity impacts are not completely understood especially for the UE impacting features. We prefer postponing this item to future releases.

4 – ZTE Corporation

Firstly, we appreciate moderator's summary, and we fully agree with moderator's suggestion to the study areas.

Secondly, we would like to response to the strong reservations as following:

As we all know, 5G-Advanced system starts from Rel-18, in our understanding there is a key scenario with high-reliability low-latency Broad-band communication (HRLL-BBC). Due to the requirement of low latency of some traffics such as XR traffic and URLLC traffic, the ARQ functionality in RLC layer needs to be closed or limited which leads to insufficient reliability. According to 5QI tables, there are many XR and URLLC traffic with high reliability, e.g., PER from 10^(-3) to 10^(-8). As a result, a possible alternative solution to ensure the reliability is network/packet coding in PDCP layer or RLC layer or a sub-layer between PDCP layer and RLC layer to close ARQ functionality in RLC layer and reduce the maximum number of retransmission of HARQ in MAC/PHY layer.

The legacy PDCP duplication has been specified in the scenario of dual-connection, selectivity diversity instead of combining diversity can be supported by the legacy PDCP duplication, which leads to insufficient usage of redundancy information and insufficient reliability performance. However, PDCP duplication enhancement based on network coding can derive combining diversity gain and improve reliability obviously. In our contribution RWS-210484 of Rel-18 workshop, for legacy PDCP duplication scheme, at least one of PER_*path1 and PER*_path2 is required to be smaller than the target PER, e.g., PER=0.001. However, for enhanced PDCP duplication based on network coding, neither PER_*path1 nor PER*_path2 needs to be larger than 0.1 for the said PER=0.001 traffic. Note that capacity can be improved if the required PER is relaxed according to Rel17-XR simulation results of the same PDB and different PER for one specific traffic, which means that reliability and capacity are interchangeable.

Besides, more simulation results in other companies' Tdocs in Rel-18 workshop also show the benefits of PDCP duplication enhancement based on network coding.

Thus we support the study of PDCP duplication enhancement based on network coding.

5 – Deutsche Telekom AG

We agree with Apple that any such network coding study should be postponed to a later release once the use cases and needs to apply network coding are more clear. We should start from the use case / needs side as motivation, not from the solutions side (”we need network coding, hence lets try to find a use case” ..)

6 – Beijing OPPO Com. corp.

We agree that PDCP duplication is a good starting point for studying network coding. But we also would like to repeat our position that before the technical study, companies should have the same understanding that network coding can really bring some benefit/performance gain. But in the current stage, we fail to see all companies are on the same position about this view. In that case, we think to evaluate the performance gain by introducing network coding based on PDCP duplication should be the first bullet of the study items.

7 – Qualcomm Incorporated

As we mentioned in our first-round comment, we do not support starting a general Study Item to explore applicable scenarios. If a Study Item is started, it should have a clearly defined focus scenario, where the network coding techniques are to be evaluated. From Qualcomm’s perspective, the focus scenario should be XR but we are open to other scenario proposals, as long as there is a clear identification of a single scenario as the outcome.

8 – LG Electronics Inc.

So far we are not convinced whether the network coding brings additional gain which justifies new concept of Layer 2 coding given that already existing features such as PDCP duplication and other IIOT enhancements have been seriously discussed to meet the requirement of URLLC traffic. Therefore, we propose not to consider network coding in Rel-18.

9 – Ericsson LM

We agree with the companies commenting there is no need for study item on this in Rel-18. We think this is a topic which warrants further studies for next generation rather than later releases of 5G.

10 – Intel Corporation (UK) Ltd

We support the areas of study that have been proposed by the moderator. As described in our comments to the Initial Round and in our contribution to the workshop, we consider that network coding can provide performance benefits to the system and that it is worthwhile for 3GPP to initiate this study in Rel-18.

11 – IISc

We would like to thank the moderator for the summary. We are in support of introducing a study item on network coding. This study could be focused in Release 18 on a single use case such as XR.

4 Final Round

Based on the input in the intermediate round, a summary and a potential set of areas/objectives (except where stated otherwise) has been proposed for each of the topics in the following sub-sections as the output of the email discussion. A last round of views on the proposed summary and areas/objectives are invited to close the discussion.

4.1 UAV (Unmanned Aerial Vehicle)

Many companies are ok with the list. Some companies think the objectives are too broad while a similar number of companies think the objectives are too narrow. It seems that there is broad support to cover LTE UAV functionality and the new requirements on ID broadcasting (from FAA). Based on this, the broad support for the current list, and focusing on items that more than a few companies have proposed, **the following is proposed as the conclusion of this discussion:**

There is broad support to start a work item on UAV (Unmanned Aerial Vehicles). The following areas/objectives can be considered further.

- Measurement reports (RAN2)
  - UE-triggered measurement report based on configured height thresholds
  - Reporting of height, location and speed in measurement report
  - Flight path reporting
  - Measurement reporting based on a configured number of cells (i.e. larger than one) fulfilling the triggering criteria simultaneously
- Signaling to support subscription-based aerial-UE identification (RAN2/RAN3/SA2 interaction)
- RRM enhancements to control volume of reports (RAN2)
- Support for broadcast/groupcast of drone identification over PC5 (RAN2)
- Study and specify if needed
  - Mobility enhancements, e.g., for CHO
  - Beam management enhancements
- Notes: Work done in LTE is a starting point

Any final feedback on the above can be provided in the form below.

Feedback Form 14: Feedback on proposed conclusions for UAV

1 – Classon Consulting

for FUTUREWEI We do not agree with the proposed conclusion and would like to see it better represent the discussion: there is broad support only for migrating the existing UAV aspects into NR and for considering the FCC requirements, and mixed/some support for additional enhancements. Then, for the list please clearly organize such that the migration objectives are grouped and the Note about LTE is near those objectives for which it is applicable, and not near the other objectives to which the note does not apply. On the Note wording itself (starting from), we feel it would be better to indicate somehow that the intent is to replicate those features in NR rather than encourage using TUs for new solutions. How to word the Note can be discussed more later, however. We would also prefer the study and specify if needed objectives be dropped or listed in [ ].

2 – ETRI

We support the proposal.

3 – Intel Corporation (UK) Ltd

We also think the work scope is too big. We should be more practical for this item.

Regarding work scope, "RRM enhancements to control volume of reports (RAN2)" should be also added under "study and specifiy if needed" as it is not clear what enhancement should be made.

For "Support for broadcast/groupcast of drone identification over PC5 (RAN2)", we can add "dependent on SA2 outcome".

4 – Guangdong OPPO Mobile Telecom.

We also think the current scope is too big. For "RRM enhancements to control volume of reports (RAN2)", we wonder what this is about and whether it hasn't been covered by "Measurement reporting based on a configured number of cells (i.e. larger than one) fulfilling the triggering criteria simultaneously"? For "Support for broadcast/groupcast of drone identification over PC5 (RAN2)", we wonder where this requirement comes from and whether this is essential to have. In general, we think the scope should be limited and prefer to reuse the LTE scope.

5 – ZTE Corporation

We are supportive to this summary in general. It's reasonable to enable the study on some new features, e.g., beam management and **power control for platoon communication**, since we are approaching the new application.

6 – China Mobile Group Device Co.

Support the updated areas/objectives.

7 – Verizon UK Ltd

Support the proposed areas/objectives

8 – AT&T GNS Belgium SPRL

We agree with the proposed objectives. Many of the objectives are simply to bring NR at par with LTE, and at least some enhancements are needed due to beam management aspects of NR. RRM enhancements are NR-specific enhancements that may be needed to reduce the volume of measurement reports. The objective is to capture this aspect so it can be looked at in RAN2 and addressed as necessary. From a operator's perspective this is an important issue because depending upon height and configuration there can be significant volume of reports generated by UAVs negatively affecting network capacity and performance.

9 – Apple Italia S.R.L.

We are fine with the proposed conclusion.

10 – Deutsche Telekom AG

We also think that the scope is too broad and we support the view of Futureway that the focus should be the mingration of LTE aspects/functionality to NR with higest priority. We said this alreday in the initial round.

If time allows (based on an honest assessment !) only then new aspects should be considered, but then it should also be discussed how LTE can be evolved to remain a en par with NR. We do not see a different

evolution for topics which are based on general requirements and are not RAT dependent. The agurment is the coverage which might involve NR as well as LTE parts ...

11 – SoftBank Corp.

OK from our side. However, it would be good if we can clarify the priority order given the different view from companies. Also, we should keep in mind that this topic is still in ”other set”, and hence we cannot expect that large number of TUs are allocated to this item. Import of LTE functionalities is the highest priority in Rel-18, and UAV should not be postponed again and again.

12 – Nokia Corporation

We also support having a UAV WI with the proposed objectives as suggested by the moderator

13 – Samsung Electronics Co.

We are generally fine with the updated areas/objectives, but we think it is reasonable that ”RRM enhancements to control volume of reports (RAN2)” puts into ”Study and specify if needed” for now as it may be a new feature.

14 – Qualcomm Incorporated

For the PC5 enhancements, we think some minimum change in RAN1 would be needed to cater for the longer range of PC5. We suggest to add ‘Support broadcast/groupcast of drone identification over PC5 of larger range communications than terrestrial V2X’.

Also, we would encourage companies to look into the band that is being defined in the US for UAV communications, we strongly believe that it would be good for 3GPP to define mechanisms to operate in this band.

On the new sub-bullet: “Measurement reporting based on a configured number of cells (i.e. larger than one) fulfilling the triggering criteria simultaneously” that was added in this round, we think another bullet “RRM enhancements to control volume of reports (RAN2)” from 1st round already covers this . If the intention is to copy the same thing in LTE to NR, the Note “Work done in LTE is a starting point” is sufficient. Different from LTE, NR supports multiple SSBs per cell. We need to discuss whether the number of cells/beams should be involved, for example. So, this new sub-bullet does not need to be explicitly mentioned and can be removed.

15 – VODAFONE Group Plc

We agree with Futurewei and DT.

16 – TELECOM ITALIA S.p.A.

Support DT’s view

17 – NTT DOCOMO INC.

we support the WI objectives summarized by moderator

18 – Lenovo Mobile Com. Technology

we agree with the listed objectives, thanks

19 – Ericsson LM

We agree with the proposal. Minor comment is that also LTE should fulfill the FCC requirements, meaning that this bullet should be both for LTE and NR:

- Support for broadcast/groupcast of drone identification over PC5 (RAN2)

20 – HUAWEI TECHNOLOGIES Co. Ltd.

Huawei, HiSilicon we are not far from an acceptable shape of the objectives. We agree with many others that ”RRM enhancements to control volume of reports (RAN2)” could be puts into ”Study and specify if needed” for now as it needs to be clarified what it means (and may be a new feature?).

For the PC5 part, we do not object to include some objective related to this, but we understand that there are different possible solutions discussed in SA2, and it is therefore not clear what needs to be done in RAN (RAN2) about this. We need to clearly state this dependency and proponents are invited to explain to everybody what enhancements are expected (depending on which solution in SA2 will be selected).

Finally still on the broadcasting of the drone ID we welcome clarifications on the security aspects. Who will be able to see the ID broadcasted and how?

21 – InterDigital

We support the proposed objectives

4.2 IIOT (Industrial Internet of Things)/URLLC (Ultra-Reliable Low-Latency Communication)

There are roughly as many or more companies that think a URLLC WI is not needed as there are companies supporting any particular objective. Also, it seems that many objectives can/will be considered in other WIs. Furthermore, some objectives have already been discussed but not agreed. Finally there are some objectives that are still being discussed in Rel-17.

If there is a IIOT/URLLC WI, it would be better to focus the objectives on items that cannot be handled in other items and that have not already been discussed without agreement. However, given all the feedback it will not be possible to reach consensus on such a list in this email discussion. Therefore **the following is proposed as the output of this email thread**:

There is no consensus on a clear set of objectives for a Rel-18 URLLC WI or that a Rel-18 URLLC WI is needed. The objectives that have been discussed as part of this email discussion are provided below in case there is further discussion on a potential Rel-18 URLLC WI (same list as in intermediate phase and will be reproduced in Conclusions section when the final output document is created).

Any final feedback on the above can be provided in the form below.

Feedback Form 15: Feedback on proposed conclusions for IIOT/URLLC

1 – Apple Italia S.R.L.

We are fine with the proposed conclusion.

2 – LG Electronics Inc.

We agree with the moderator that, for now, it is difficult to extract a list that can be discussed under R18 IIOT. In the meanwhile, we see some consensus that some of the list could be considered in other WI/SI. Therefore, it would be helpful to indicate those topics additionally so that they can also be considered in the relevant items. We're not insisting to exclude those proposals from R18 IIOT, if we have, but we would like to make a bit more progress on the list by indicating at least those objectives which have been considered to be covered under other items by many companies. In our view, sufficient number of companies indicated that the objectives listed below can be discussed/covered under other items.

- URLLC in INACTIVE mode
- URLLC with high data rate
- CG/SPS enhancement
- Sidelink URLLC enhancement for IIOT
- FR2 improvement.

If we have R18 IIOT, the objectives should be carefully set by coordination with other similar items. Therefore, we believe having list of a potential overlapped objectives would be helpful when we see the need/volume of R18 IIOT.

3 – Motorola Mobility España SA

Lenovo/Motorola Mobility

Atleast some companies showed interest to start studying Sidelink IIoT/URLLC compared to other URLLC/IIoT topics where there is no clear majority. For companies proposing to discuss Sidelink IIoT/URLLC as part of the sidelink enhancement did not object to study sidelink positioning as a separate work item which is strange. It would nice to analyze the market needs, views from vertical partner for Sidelink URLLC/IIoT within the scope of IIoT/URLLC thread and later decide how/where to scope this item.

4 – Nokia Corporation

We are fine with the proposed conclusions from the moderator.

We remain interested on the following items:

- FR2 URLLC
- URLLC UE profile (could be RAN level also)
- Synchronization aspects
- Real-time multiple UE back up

We are not interested on the sidelink aspects for URLLC at this point in time, knowing with the basic URLLC UE definition being unclear. The basic URLLC UE definition is something which could be addressed in RAN level (starting from simple Release 15 capabilities).

5 – Guangdong OPPO Mobile Telecom.

As summarized by moderator, there is no consensus on the need or what to cover. But, we can keep an eye on the progress of other SIs/WIs and pull R18 IIoT/URLLC WI back in case some interested objectives are not involved. Currently, we are fine with moderator's proposal.

6 – Qualcomm Incorporated

As summarized by the moderator, there seems to be a very large number of proposed enhancements with very little convergence. We would like to highlight once again that most of the enhancements listed are for Uu – the work in this release should be focusing more on PC5 for URLLC. This can be considered under a sidelink work item.

7 – VODAFONE Group Plc

The moderator's proposal seems OK.

8 – TELECOM ITALIA S.p.A.

agree with the moderator

9 – ZTE Corporation

I agree with moderator that it is not easy to reach a consensus on a clear set of objectives supported by most of companies for a Rel-18 URLLC WI. But it is observed that many companies have interests and the same views on some objectives deserved to be justified in a dedicated Rel-18 URLLC WI, at least including:

- FR2 improvement for URLLC/IIoT with tight URLLC requirements (Supporting companies: 6)
- Cross-carrier operations for TDD with different UL/DL configurations, at least including flexible HARQ retransmission and/or repetitions (Supporting companies: 3)
- Real-time UE backup (Supporting companies: 5)
- Rel-17 leftovers which depends on the outcome of Rel-17 URLLC (Supporting companies: 5)

Technically, above items are not suitable to be merged into other WI. It is not clear that the objectives discussed here would be accepted by other Rel-18 WIs. Then we suggest not closing the door for Rel-18 URLLC WI now, and keep discussion on the objectives which may not be merged into other WIs.

10 – NTT DOCOMO INC.

Agree with Nokia's view.

11 – Ericsson LM

We are fine with the proposed conclusion by Moderator.

12 – China Mobile Com. Corporation

As summarized by moderator, there is no consensus on the need or what to cover due to overlapping with other potential WID/SID, (e.g. XR and FR2 mobility) or having been discussed without agreement. However, it is tricky to move the item of "Real-time multiple UE back up" (i.e. dual-UE based URLCC enhancement) to other WID/SID, which is aiming to target the high reliability by Real-time multiple UE back up. This can address the issue that the existing approaches for high reliability are only relying on the reliability of one single terminal. So far, this mechanism has not been discussed and studied yet, which is not within the scope that having been discussed without agreement. Moreover, the commercial requirement of this mechanism is tangible and clear, especially in the use cases of factory automation, transport industry and electrical power distribution automotive.

13 – HUAWEI TECHNOLOGIES Co. Ltd.

We can understand it is difficult to achieve consensus at this stage. However, we do see some of the areas in the list is more appropriate in a dedicate URLLC WI and worthwhile to set up a dedicate URLLC WI as we commented in previous round with detailed analysis, e.g.,

- Cross-carrier operations for TDD with different UL/DL configurations, at least including flexible HARQ retransmission
- FR2 improvement for URLLC/IoT deployments, at least including beam management and greater number of TRPs
- Enhancement for equipment reliability, including UE backup
- Rel-17 leftovers, e.g., SPS HARQ-ACK skipping, CSI enhancements, etc.

14 – Sony Europe B.V.

Although we agreed with the moderator's observation that there is no consensus in having a Rel-18 URLLC topic, we also observed that there are topics that are unique to URLLC and some may not be easily lumped into another WI just because they share similar acronyms. The topics that we think should be in Rel-18 URLLC are:

- Backup UE (or Multi-UE)
- Sidelink URLLC. If there is a URLLC WI we believe URLLC SL should be discussed in URLLC rather than SL WI. We do not lump every feature into a "Uu" WI even though most WI would involve the Uu interface. Similarly, we shouldn't lump random features into SL WI just because they have the name "Sidelink" in it since URLLC have different requirements and addresses different industries.
- Out of Order PUSCH and PDSCH scheduling. This feature was considered in Rel-16 but not pursued due to lack of progress and time. This feature has a lot of supports and so it should be considered again in Rel-18
- PDCCH reliability. URLLC introduced DCI 0*2 and 1*2 formats but the reliability of the PDCCH was mostly not considered further. Some reliability enhancements can be CSI/ACK for PDCCH and PDCCH repetitions

15 – ROBERT BOSCH GmbH

Most of the discussion includes enhancements for Uu URLLC; however, Rel-18 should focus on Sidelink/PC5 URLLC. The particular enhancements mentioned for SL URLLC should be carefully reconsidered for the sidelink work item. We would support re-open the discussion for SL URLLC enhancements specifically here or in the SL enhancements WI.

16 – Intel Corporation (UK) Ltd

We are fine with the moderator summary.

We are still interested in the following topics:

- NR-U enhancements
- Sidelink URLLC enhancements for IIoT use cases
- Cross-carrier operations for HARQ retransmission and repetition including multi-TRP aspects.

- SPS/CG enhancements

We observe that Sidelink URLLC enhancements for IIoT has relatively wide support. As in our comments for Intermediate round, we prefer that at this stage to focus on the technical areas, and the WI in which any technical area is placed can be concluded at a later stage.

17 – Samsung Research America

The proposed conclusion by the moderator accurately reflects the inputs from companies. We support several of the proposed small-scale, self-contained, enhancements and they may be considered in other possible SIs/WIs.

18 – InterDigital

We agree with ZTE that it is currently hard to reach a consensus, but that a Rel-18 URLLC WI should not be precluded at this time.

4.3 <5 MHz in Dedicated Spectrum

From the feedback, it seems that most companies support the objectives in general with some doubts expressed regarding the need for changes to PUCCH and some clarifications sought for the PDCCH and CSI-RS aspects. The point about restricting this work to dedicated spectrum has also been raised by many. The moderator assumes that the use of ”dedicated FDD FR1 spectrum” in the first objective should leave no room for confusion on this point. Based on the feedback **the following is proposed as the output of this discussion**:

There is good support for work in Rel-18 on bandwidths lower than 5 MHz in dedicated spectrum with most companies supporting a work item while some have raised the possibility of a study first. The following areas/objectives can be considered further:

- 3-5 MHz in dedicated FDD FR1 spectrum (RAN1)
  - SCS and CP: 15 kHz with normal CP
  - SSB: PSS/SSS without puncturing, reuse PBCH while minimizing performance degradation
  - [PDCCH: No new CORESET#0 size]
  - [CSI-RS/TRS with flexible bandwidth]
  - PRACH format restriction with UL BW < 5 MHz
  - If necessary, PUCCH changes without affecting performance
- Changes to support deploying NR (RAN4)
  - System parameters including channel and sync rasters
  - RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS and specify RF requirement of 3 MHz BW for other cases)

Final feedback on the proposed conclusions above as well as clarifications to the questions asked on the items in square brackets can be provided in the feedback form below.

Feedback Form 16: Feedback on the proposed conclusions for <5 MHz bandwidth in dedicated spectrum

1 – Omnispace

We support the need for sub 5 MHz bandwidth channels in NTN FR1. Such narrower channels will allow more optimized use of spectrum and power in spotbeams with very little expected traffic. Allowing the deployment of spectrum in segments optimized for the traffic allows for the limited power available on the satellite to be effectively used to provide service, not illuminate unneeded downlink spectrum merely because of channel size limitations.

2 – Lockheed Martin

Lockheed Martin supports the proposed conclusions for <5 MHz bandwidth in dedicated spectrum.

3 – Apple Italia S.R.L.

We are generally fine with the proposed conclusion. It would be good to put PUCCH bullet also in bracket, since it is still not clear to us the motivation and the potential solutions being considered.

4 – Anterix

Anterix appreciates the summary provided and supports the summary provided in **section 4.3 for <5 MHz Bandwidth in dedicated spectrum** and appreciate the support from members in moving this proposal forward in Rel-18. To be very clear the intent is to minimize changes to L1 and implement this in the FR1 bands (e.g. Bands n8, n26, n28 and RMR-900) identified for utilities, railways and PPDR. Several companies let their concerns be known regarding any changes to PDCCH, PUCCH and CSI-RS/TRS. This proposed WID is intended to reuse CORESET#0 with puncturing but should have no new numerologies with no new CORESET#0 size (with the exception of puncturing) or changes to sync signals (including no puncturing).

We would recommend that there be some clarifications to note that for the PDCCH section in that it will reuse CORESET#0 *with puncturing*. For the concerns regarding CSI-RS/TRS we want to ensure that this transmission is maintained within the CBW.

We look forward to moving ahead on this and continuing to collaborate.

5 – ZTE Corporation

Based on the submitted contribution to RWS-Rel18, 3MHz CBW matches well with the request from smart grids in US and PPDR in Europe, however for FRMCS in Europe, the potential available spectrum for FRMC could vary between 2.8MHz and 3.6MHz depending how many GSM-R carriers would be preserved, we want to know whether 2.8MHz or 3.6MHz for FRMCS has already been precluded or not if only 3MHz is considered.

In addition, we also encourage to provide band information for FRMCS, smarter grids, PPDR by operators which is critical for RAN4 further work. Similar comments raised by other companies, UE types should also be clarified for further discussion.

6 – Nokia France

The Moderator's summary is well written.

For PDCCH, the key point is that changes should be minimised. It is possible to reuse the existing CORESET#0 size with some of RBs unused for PDCCH transmission. One way to formulate it could be "PDCCH: consider minimum changes to existing CORESET#0, e.g. puncturing where necessary".

For CSI-RS/TRS, the meaning of ”flexible” is that the bandwidth should be able to be limited within the available dedicated spectrum.

In response to ZTE’s comments above, the intention is to define only one new channel bandwidth of 3MHz, but for FRMCS with spectrum sharing with the same operator for NR and GSM-R within 5.6MHz, other transmitted bandwidths can be used as necessary. We already tried to clarify the UE types in the earlier discussion round.

7 – vivo Communication Technology

1. We do not see the clear need to change PUCCH design. We support Apple’s suggestion to put PUCCH bullet also in [].

2. Regarding the RAN1 objectives, it seems to us the underlined ones are more like a design assumptions, rather than working objectives. Normally we use ”Notes” to state such design assumptions in the WID.

3-5 MHz in dedicated FDD FR1 spectrum (RAN1)

- SCS and CP: 15 kHz with normal CP
- SSB: PSS/SSS without puncturing, reuse PBCH while minimizing performance degradation
- [PDCCH: No new CORESET#0 size]
- [CSI-RS/TRS with flexible bandwidth]
- PRACH format restriction with UL BW < 5 MHz
- If necessary, PUCCH changes without affecting performance

8 – Deutsche Telekom AG

We are not interested in this work at all, but want to emphasise that this is ONLY applicable in ”dedicated spectrum” ... while this theard and interested people will understand waht ”dedicated” means, we suggest changing ”dedicated spectrum” to ”in specfic NR bands” or ”in concrete NR bands” to avoid any misunderstanding the word ”dedicated” might imply ...

9 – Samsung Electronics Co.

To be fair, we also think that PUCCH-related bullet should be in the bracket. Except this, we are fine with Moderator’s proposed conclusion.

10 – Swiss Federal Railways Ltd

UIC (International Union of the Railways)

UIC appreciates about the well written summary and would underline to have as less as possible impact on existing 5G NR concept and corresponding specifications. The question about FRMCS band information is currently under discussion in RAN4. The progress of the ongoing work can be monitored in 3GPP TR 38.853.

11 – Qualcomm Incorporated

In general, the Chairman’s summary is in good shape. A few more comments for clarification:

- For PDCCH with minimum changes, it is possible to reuse existing CORESET#0 design with some of RBs unused for PDCCH transmission. Can we say ‘PDCCH: consider existing CORESET#0’ without brackets?

- For CSI-RS/TRS, the only concern from ZTE/Huawei is that the 'flexible' here is not clear. The intention is to limit the CSI-RS/TRS transmission within the restricted dedicated spectrum since the min BW of NR CSI-RS/TRS is 5MHz. We suggest "CSI-RS/TRS transmission no larger than the dedicated spectrum", instead of putting this bullet into brackets.

12 – TELECOM ITALIA S.p.A.

similarly to what DT stated, this feature should no tbe applicable in all of n28, but only in those sub-bands allocated to PPDR

I believe a new band should be defined

13 – Huawei Tech.(UK) Co.. Ltd

If there is a SI/WI on this topic:

- For the second bullet "reuse PBCH while minimizing performance degradation": the word "reuse" may conflict with "minimizing performance degradation". Maybe it is "based on"?
- For the two bullets of PDCCH and CSI-RS/TRS with brackets, the unclear points are not resolved. But they can stay here in brackets if no better wording can be found right now.
- For what kind of UE would be allowed to access this dedicated system, if the intention is no limitation on any existing 3GPP defined UEs, it is better to add a note to clarify this point.

14 – ZTE Corporation

To Nokia, the physical design and spectrum utilization for 3MHz might be not suitable for 2.8MHz and 3.6MHz based on our initial analysis especially on how many PRBs would be used for PBCH channel.

For UE types, it's better to add some notes in the objectives, otherwise it might be confusing to initiate RAN4 RF work.

15 – InterDigital

We support the proposed conclusions

4.4 Other IoT Enhancements/Types

Based on the feedback, while there is support for a study focused on passive IoT, there are also many companies that don't believe this study should occur in Rel-18. Therefore, **the following is proposed as the conclusion of this discussion:**

There is interest among many companies for a study focusing on passive IoT, but there are also multiple companies that such a study in Rel-18 is premature. In case there is further discussion on such a study, the following objectives that were discussed as part of this discussion can be considered:

- Study of use cases and design targets for passive IoT for power consumption, complexity, link budget (RAN1/2/4, RAN)
- Identification of key areas to enhance to achieve design targets of passive IoT for power consumption, complexity, link budget (RAN1/2/4)

Final feedback on the proposed conclusions above can be provided in the form below.

Feedback Form 17: Feedback on the proposed conclusions for other IoT enhancements/types

1 – Classon Consulting for FUTUREWEI We are supportive of the moderator proposed conclusion. The upside of Passive IoT could be very large for 3GPP, and we need these sorts of impactful studies in our Rel-18 package.
2 – Apple Italia S.R.L. We are fine with the proposed conclusion. We do not see the urgent need to start the study on passive IoT in Rel-18.
3 – Samsung Research America The moderator conclusion is fine. We think it is premature to study passive IoT in Rel-18.
4 – vivo Communication Technology We think some study activity on Passive IOT can be started in Rel-18, the potential scope as proposed by the moderator can be a good starting point.
5 – Deutsche Telekom AG This could be the starting point for a Rel-19 Study, but we think this is premature for Rel-18
6 – Motorola Mobility France S.A.S **Lenovo/Motorola Mobility** The moderator's conclusion and potential scope/objectives is fine for us. We would be supportive of having some study on passive IoT in Rel-18.
7 – China Telecommunications We support the proposed conclusion. We see the use case demands from industrial customers and prefer to have the study during Rel-18.
8 – NTT DOCOMO INC. We support moderator proposed conclusion.
9 – Qualcomm Incorporated The bullets above could be a good starting point, but we may need further refinement closer to the approval of the study item in a future release.
10 – China Unicom We support the moderator's proposal on the objective. We believe passive IoT will be beneficial for industrial customers, and study item should be considered in R18.

11 – China Mobile Com. Corporation

We support the moderator's summary for Passive IoT. Considering the requirement from vertical is quite strong, we would like to at least have a study item in Rel-18.

Besides, we still prefer to add the study for Inter-UE Handover or Replication for Same User into to this sub-agenda item as well, since a tangible commercial requirement can be expected and this requirement has been confirmed by SA1.

12 – ZTE Corporation

We are fine with the moderator's conclusion.

13 – Philips International B.V.

We agree with proceeding with a SI on passive IoT for Rel-18 with the objectives suggested by the moderator

14 – Huawei Tech.(UK) Co.. Ltd

We are OK with the moderator's conclusion, and assume there will be further discussion on passive IoT in preparing the Rel-18 package. Rel-18 is the right time to signal and begin 3GPP's engagement with this technology.

15 – Ericsson LM

We agree with the conclusion, but reiterate that Rel-18 is too early. Hence, we prefer to close this discussion and revisit in a release later than Rel-18

16 – Fraunhofer IIS

We would like to start with WUR/WUS study and postpone Passive IoT until the use cases are more clear. We are unsure about the market opportunities with a new RFID-like technology. The advantages of an established 3GPP deployment that might be reused are unclear at the moment and could be further discussed.

17 – CAICT

we support moderator's proposal and it is a good start point for the study of Passive IOT

18 – MediaTek Inc.

Thanks for moderator's summary. We see there is interest in studying passive IOT topic. Rel-18 package can discuss such possibility, considering proper coordination with SA to maximize overall 3GPP work efficiency.

19 – InterDigital

We support the moderator's conclusion

4.5 HAPS (High Altitude Platform System)

There is support among many companies for the study with some modifications but also views expressed by multiple companies that this is covered already and a separate study is not needed. There seems to be greater support for the objectives under the first bullet. While there have been changes suggested to this first bullet

and sub-bullets there are conflicting inputs on the changes. Given the situation, **the following is proposed as the conclusion of this discussion:**

There is support among many companies for a study on HAPS deployment and configuration scenario(s), that may not be addressed by the current work on NTN. However, multiple companies think that a separate study is not needed. To address concerns regarding adequate coverage of HAPS, an objective specific to HAPS can be added to a potential Rel-18 WI on NTN with the objective covering any standard changes that may be necessary specifically for HAPS deployments and configurations. In addition, TR 38.821 can be updated based on the HAPS-specific deployment and configuration aspects identified as part of this work. The objectives that had wider support as part of this discussion are provided below in case there is further discussion on work in HAPS for Rel-18 either as part of an objective within work for NTN or as a separate study:

- Development of HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821.
    - Determination of HAPS scenario(s) (RAN1/4)
    - Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)Mobility and interference study considering spectrum (RAN1/2)
    - Mobility and interference study considering spectrum (RAN1/2)
    - Applicability of TDD from remote interference PoV (RAN1)
    - Applicability of regenerative and transparent payload (RAN2/3)

Final feedback on the above proposed conclusions can be provided in the form below. Note that the sub-bullets under the first bullet have been left unchanged due to the conflicting inputs on these bullets as mentioned earlier.

Feedback Form 18: Feedback on the proposed conclusions for HAPS

1 – ETRI

We generally support the proposal.

Regarding the third sub-bullet, we think the following suggestion from Lenovo can be considered:

- Mobility, **beam management** and interference study considering spectrum (RAN1/2)

2 – SoftBank Corp.

Thanks for Moderator for your hard work. Given the discussion so far, the moderator's proposal reflect the situation very well, and **we support the observation by moderator.**

Just a for clarification from our side about the sub-bullets. The sub-bullets come from our analysis on TR38.821, and there are indeed problematic parts and corrections are absolutely needed from HAPS perspective. I understand companies have different understanding/expectation on the amount of work (including zero work), but our decision here should be made based on the necessity of correction no matter how big or small the issue is. I can give you concrete examples below for your reference:

- No HAPS scenarios are defined in section 4.1 and 4.2, which is critical (the most important part!!)

- In section 7.1.1, it is mentioned that ”Down-prioritize TDD”. This description may be applicable only to delay issue, but it is clear that TDD itself is ruled out from the study, even though TDD might be available for HAPS.
- Section 5 (Architecture including payload type) is described from satellite point of view, i.e. terminology ”satellite” is used instead of ”NTN”. It is not clear if the completely same thing is applicable to HAPS or not.
- In section 5.4, there is a description about the spectrum, but only satellite operations are assumed. Hence, co-channel deployment between TN and NTN(HAPS) is missing from the TR.
- No simulation assumptions for HAPS are defined in section 6.1. This makes future evaluation campaign difficult.
- Mobility analyses in 7.3 are described from satellite scenarios point of view (i.e. satellite scenarios are explicitly referred here). It is no clear if the same applies to HAPS scenarios or not.

Please note that there are other sections that need correction. I believe small corrections can be done anyway during the SI phase or simply by maintenance.

As for the addition of beam management proposed by Lenovo, we checked the description in section 6.2.4 of TR38.821, and it seems that the analyses were performed based on satellite scenarios, and some clarification may be necessary. Thus, their proposal to add “beam management” in the sub-bullet looks reasonable. We are OK to add it. Hope it is not so controversial.

Finally, there is a minor type in Moderators proposal: ”Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)Mobility and interference study considering spectrum (RAN1/2)” should be separated into two bullets.

3 – Guangdong OPPO Mobile Telecom.

No matter whether to consider HAPS for Rel-18 either as part of an objective within work for NTN or as a separate study, we prefer to keep it as lower priority in Rel-18.

4 – ZTE Corporation

In general, we are supportive to the intention of this summary. But clarification on some items is still needed. For example, regarding the mobility and interference study, it seems that the duplicated description is listed in both the 2nd and 3rd bullet. Moreover, for the TDD part, if the intention is to study the generic applicability for TDD case, we prefer to other remove the description of later part. Otherwise, it can also be included in the 1st bullet along with discussion on other interference. For the regenerative part, maybe we can discuss it jointly with satellite in NTN if corresponding scope is included.

5 – AT&T GNS Belgium SPRL

We continue to believe that this is a low priority item for Rel-18. Some of the objectives are complex and can take away precious 3GPP resources. The goal should be to maximize as much commonality with NTN work as possible to support HAPS.

6 – Apple Italia S.R.L.

We support the direction of the proposal, i.e., to discuss further whether to include it as an objective in Rel-18 NTN work item or as a separate study. Regarding the sub-bullets, we may want to exam them together with NTN objectives. For example, regenerative payload is also considered in NTN, which may cover the last sub-bullet for HAPS.

7 – Samsung Electronics Co.

We think this can be discussed in Rel-18 NTN and it seems determination of HAPS scenarios could be the first work to study. The other things would be second priority.

8 – China Unicom

We agree with moderator proposal. We share the same view with ETRI that beam management should be added into sub-bullet 3. Whether to have a seperate SI or mergerd into NTN can be furthrer decided in Dec. meeting.

9 – DOCOMO Communications Lab.

We support this moderator proposal. In our understanding, ”Determination of HAPS scenario(s)” includes inter-HAPS link and our preference is to add this aspect explicitly, as commented in intermediate round.

10 – Qualcomm Incorporated

We think the highest priority should be given to studying the scenarios and potential issues first.

11 – Ericsson France S.A.S

Our understanding is still that the specifications support HAPS, and adaptations relating to the scenarios are issues for network configuration. However, as suggested in the summary if issues that need spec additions are found then they can be addressed in the NTN WI. Also the TR should be updated to be clear that HAPS is covered. With this in mind, we think that the objectives for the NTN could be captured as follows:

- Address HAPS deployment and configuration scenario(s) for which the current specifications are not sufficient, if identified.
  - Possible aspects not covered in current specs might include

  - Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and HAPS (RAN4)
  - Mobility and interference considering spectrum (RAN1/2)
  - Applicability of TDD from remote interference PoV (RAN1)
- - Applicability of regenerative and transparent payload (RAN2/3)
- Ensure that the TR 38.821 adequately captures that HAPS deployment scenarios are taken into account and enabled in the NTN related specifications.

12 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility

We support the proposal and would prefer it as a separate study. We think, the first and third sub-bullets may be modified as

- Determination of HAPS scenario(s) **including inter-HAPS link** (RAN1/4)
- Mobility, **beam management** and interference study considering spectrum (RAN1/2)

13 – Intelsat We support the proposal and support Lenovo's proposal to add beam management to the third bullet on mobility. We also agree with the inclusion of inter-HAPS links in the determination of scenarios.
14 – HUAWEI TECHNOLOGIES Co. Ltd. *We support moderator recommendation to develop HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821. Detailed objectives can be further discussed as recommended by moderator.*
15 – Nokia France This seems a good summary of the current status.
16 – KDDI Corporation We support this moderator recommendation and also think that the clarification on necessary to study HAPS from Softbank has justification to agree with Rel-18 HAPS study. Developing HAPS deployment and configuration scenarios are not studied in TR38.821. Detailed objectives can be further discussed as recommended by moderator.
17 – InterDigital We support the proposed conclusion

4.6 Network Coding

Based on the feedback, **the following is proposed as the conclusion of this discussion:**

There is no consensus to start work in Rel-18 on network coding. The objectives that were discussed as part of this email discussion are provided below for consideration in case there is any further discussion on network coding in Rel-18.

- Study of layer(s) on which network coding should be performed including study of protocol stacks of network coding based on PDCP duplication, e.g., network coding layer between RLC and PDCP (RAN2)
- Identification and evaluation of scenarios (e.g. URLLC, DC, IAB, etc.) where Layer-2 packet coding can be introduced with benefits including PDCP duplication enhancements based on network coding
- Identification of architecture and protocol impacts for applying Layer-2 packet coding to various scenarios.

Final feedback on the above conclusions may be provided in the form below.

Feedback Form 19: Feedback on conclusions for network coding

1 – LG Electronics Inc.

As there is no consensus and no big urgency is identified to consider Network Coding in Rel-18, we would like to suggest to clearly indicate that Network Coding is not to be included in Rel-18 WI unless it is strongly motivated based on the performance evaluation and/or targeted scenarios.

2 – Beijing OPPO Com. corp.

As we observed during the previous two rounds of email discussion, it is quite debatable to put the study of network coding into Rel-18 package. Thus, we suggest to postpone this study to the future release. And thus we can just report "There is no consensus to start work in Rel-18 on network coding.", but no need to mention the detailed bullets.

3 – Deutsche Telekom AG

We agree with LGE

4 – Nokia France

We agree with Oppo.

5 – ZTE Corporation

We support the areas of study proposed by the moderator. According to our comments to the first two rounds and our contribution in the workshop, we think that packet-wise network coding can provide better reliability performance than legacy retransmission techniques for XR and URLLC traffic, especially in the case of multi-path network, broadcasting network, and mesh network. Therefore, it is reasonable for 3GPP to begin this study in Rel-18.

6 – Ericsson LM

We agree with the moderator conclusions on this topic.

7 – Qualcomm Incorporated

The proposal is acceptable to us. From Qualcomm's perspective, we are interested in pursuing network coding as part of the techniques considered for the XR WI.

8 – Intel Corporation (UK) Ltd

We have expressed our view several times over the course of the workshop and this email discussion that we consider that network coding can provide performance benefits to the 3GPP system. We still think that this would be a worthwhile topic for RAN to study in Release 18 in order to fully explore potential applications and performance benefits. However, we acknowledge the observation from the moderator that there is no consensus to include this work in Rel-18, and we can accept the moderator's conclusion.

9 – Huawei Tech.(UK) Co.. Ltd

We support Moderator's conclusion on this topic (i.e. no consensus), and we also don't see network coding as high priority in Rel-18.

10 – InterDigital

We acknowledge that there is no current consensus to support a Rel-18 Network Coding study.

5 Conclusions

5.1 UAV

5.1.1 Summary

There is broad support to cover LTE UAV functionality and the new requirements on ID broadcasting (from FAA) in a new work item. There is support for additional enhancements but also some views that these are not necessary.

5.1.2 Proposals

Proposal:

The following areas/objectives can be considered as a starting point for further discussions on UAV

- Measurement reports (RAN2)
  - UE-triggered measurement report based on configured height thresholds
  - Reporting of height, location and speed in measurement report
  - Flight path reporting
  - Measurement reporting based on a configured number of cells (i.e. larger than one) fulfilling the triggering criteria simultaneously
- Signaling to support subscription-based aerial-UE identification (RAN2/RAN3/SA2 interaction)
- Note: Work done in LTE is a starting point for the above objectives intended to cover LTE UAV functionality including any NR-specific enhancements as necessary
- Support for broadcast/groupcast of drone identification over PC5 dependent on SA2 outcome (RAN2)
  - [Applicable to both LTE and NR]
- Study and specify if needed
  - [Additional RRM enhancements to control volume of reports (RAN2)]
  - [Mobility enhancements, e.g., for CHO]
  - [Beam management enhancements]

5.2 IIOT/URLLC

5.2.1 Summary

There is no consensus on a clear set of objectives for a Rel-18 URLLC WI or that a Rel-18 URLLC WI is needed. Many objectives be considered in other WIs. Some objectives have already been discussed but not agreed. There are some objectives that are still being discussed in Rel-17.

However, there is interest among many companies to have a URLLC work item although views on what it should cover are very divided. It seems clear though that objectives that are included in other WIs should not

be discussed for a potential URLLC WI. The objectives that have been discussed as part of this email discussion are provided in Section 2.3 of RP-211665 to be considered in further discussions on a potential Rel-18 URLLC WI.

5.2.2 Proposals

Proposal:

Further discussions on URLLC in Rel-18 should focus on objectives that will not be addressed in other work items. The objectives that have been discussed as part of this email discussion are provided in Section 3.2 of RP-211665 and can be considered in further discussions on a potential Rel-18 URLLC WI.

5.3 <5 MHz in Dedicated Spectrum

5.3.1 Summary

There is good support for work in Rel-18 on bandwidths lower than 5 MHz in dedicated spectrum with most companies supporting a work item while some have raised the possibility of a study first. Strong concerns have been expressed that this work should only be limited to spectrum dedicated to bands identified for utilities, railways and PPDR.

5.3.2 Proposals

Proposal:

The following objectives can be considered as a starting point for further discussions on <5 MHz in dedicated spectrum.

- 3-5 MHz in dedicated FDD FR1 spectrum (RAN1)
  - SCS and CP: 15 kHz with normal CP
  - SSB: PSS/SSS without puncturing, PBCH based on current design while minimizing performance degradation
  - [PDCCH: Consider minimum changes to existing CORESET#0, e.g. puncturing where necessary]
  - [CSI-RS/TRS with flexible bandwidth]
  - PRACH format restriction with UL BW < 5 MHz
  - [If necessary, PUCCH changes without affecting performance]
- Changes to support deploying NR (RAN4)
  - System parameters including channel and sync rasters
  - RF requirements for bands while minimizing impacts (reuse 5 MHz BW at least for FRMCS and specify RF requirement of 3 MHz BW for other cases)
- Notes:
  - This work is only applicable to FR1 bands identified for utilities, railways and PPDR.
  - [Potential clarifications on UE types based on further discussions]

5.4 Other IoT Enhancements/Types

5.4.1 Summary

There is interest among many companies for a study focusing on passive IoT, but there are also multiple companies that indicate that such a study in Rel-18 is premature. In case there is further discussion on a study for other IoT enhancements/types, the objectives discussed here can be further considered.

5.4.2 Proposals

Proposed Conclusion:

There is interest among many companies for a study focusing on passive IoT, but there are also multiple companies that indicate that such a study in Rel-18 is premature. In case there is further discussion on a study for other IoT enhancements/types, the following objectives that were discussed as part of this discussion can be considered:

- Study of use cases and design targets for passive IoT for power consumption, complexity, link budget (RAN1/2/4, RAN)
- Identification of key areas to enhance to achieve design targets of passive IoT for power consumption, complexity, link budget (RAN1/2/4)

5.5 HAPS (High Altitude Platform System)

5.5.1 Summary

There is support among many companies for a study on HAPS deployment and configuration scenario(s), that may not be addressed by the current work on NTN. However, multiple companies think that a separate study is not needed. To address concerns regarding adequate coverage of HAPS, an objective specific to HAPS can be added to a potential Rel-18 WI on NTN with the objective covering any standard changes that may be necessary specifically for HAPS deployments and configurations. In addition, TR 38.821 can be updated based on the HAPS-specific deployment and configuration aspects identified as part of this work. The objectives that had some support as part of this discussion are provided in the next section in case there is further discussion on work in HAPS for Rel-18 either as part of an objective within work for NTN or as a separate study.

5.5.2 Proposals for endorsement

Proposal:

Further discussions on HAPS in Rel-18 should consider whether an objective specific to HAPS can be added to a potential Rel-18 WI on NTN with the objective covering any standard changes that may be necessary specifically for HAPS deployments and configurations and whether TR 38.821 can be updated based on the HAPS-specific deployment and configuration aspects identified as part of this work.

Proposal (controversial):

The following objectives can be considered as a starting point in case there is further discussion on work in HAPS for Rel-18 either as part of an objective within work for NTN or as a separate study:

- Development of HAPS deployment and configuration scenario(s), which are not studied and missing in TR38.821.
- Determination of HAPS scenario(s) (RAN1/4)
- Co-ex study with other HAPS and/or TN, i.e., leftovers from Rel-17 including frequency sharing between TN and NTN (RAN4)
- Mobility, beam management and interference study considering spectrum (RAN1/2)
- Applicability of TDD [from remote interference PoV] (RAN1)
- Applicability of regenerative and transparent payload (RAN2/3)

5.6 Network Coding

5.6.1 Summary

There is no consensus to start work in Rel-18 on network coding. The latest objectives that were discussed as part of this email discussion are in Section 4.6 of RP-211665.

5.6.2 Proposals

Proposed Conclusion:

There is no consensus to start work in Rel-18 on network coding.

6 References

1. RWS-210659, ”Summary of RAN Rel-18 Workshop”, RAN Chair

2. RP-211639, ”Additional Guidance on RAN Rel-18 Email Discussion during August 30th and September 3rd”, RAN Chair