RAN-R18-WS-non-eMBB-Fraunhofer - Version 0.0.7
RAN

3GPP TSG RAN Rel-18 workshop **RWS-210570**

Electronic Meeting, June 28 - July 2, 2021

Agenda Item: 4.2

Source: Fraunhofer HHI, Fraunhofer IIS

Title: Email discussion summary for [RAN-R18-WS-non-eMBB-Fraunhofer]

1 Introduction

This document is used for the email discussion before the Rel-18 workshop to collect for questions & comments from companies for the contributions of Fraunhofer under agenda item 4.2.

Fraunhofer submitted 5 contributions under agenda item 4.2, including the topics:

- NTN enhancements [1],

- NR positioning [2],

- Sidelink positioning [3],

- IoT [4], and

- Enhanced sidelink features [5].

The deadlines for this Q&A will be the following:

Round 1 Q&A: Questions: June 14 08:00 UTC – June 17 8:00 UTC; Answers: June 17 8:00 UTC – June 18 23:59 UTC

Round 2 Q&A: Questions: June 21 08:00 UTC – June 23 8:00 UTC; Answers: June 23 8:00 UTC – June 24 18:00 UTC

2 [1st Round] Comments/Questions

For general comments and questions, please use the feedback form below.

Feedback Form 1: General Comments/Questions in 1st round

1 – THALES All proposed canditate NTN enhancements are of interest. Any idea of priorisation ?

2.1 Comments on NTN [1]

Feedback Form 2: Comments/Questions on NTN

1 – Asia Pacific Telecom co. Ltd

We wonder how small BW (<5) we shall support for cube satellite deployment.

2 – ESA

The list of features in RWS-210321 are supported by us. Luckily, most of them are also suggested and supported in other "NTN enhancements" documents from many 3GPP companies. I would like to highlight some of your keywords not listed in other contributions of relevance for us: 1) Flexible BWP management to support beam-hopping satellite systems, 2) PAPR techniques and waveform improvements for energy efficient transmissions.

3 – Intelsat

We agree with the list of enhancements in RWS-210321. We believe a study of the CU/DU split architecture is interesting, we also support a waveform study.

4 – Inmarsat

We support the proposals from Fraunhofer, in particular waveform efficiency related enhancements (e.g. low-PAPR waveform support)- we should aim for parity (or better) than current state of the art satcom waveforms.
Smaller bandwidth configurations and flexible BWP configurations are the second priority (can be used for more flexible channelization and beam hopping).
ISL with IAB support and NTN positioning are interesting areas as well.

5 – Intel Corporation (UK) Ltd

Q1: For DFT-s-OFDM waveform in DL, do you expect very large amount of work in RAN1?

Q2: Enabling NR NTN without GNSS at the UE will lead to decreased system performance due to larger PRACH reception window (especially for GEO) and frequent PRACH transmission (especially for LEO). Do you expect that significant part of connections will correspond to UEs without GNSS?

6 – CATT

We are pretty much aligned in several topics like support of Regenerative Arahitecture, coverage enhancement, Positioning enhancement, etc.

For CU-DU split option, maybe we could further work in the future release, and we could focus on the very basic case, full gNB on board case.

For indirect access,what's the scenario and use case? is it like UE access via CPE?

7 – Sony Corporation

Thanks for the contribution. We have a question.

-

"*Enable access by terrestrial UEs via SL to NTN-enabled UEs*"

- Is the proposal for sidelink relay? How is this different to R17 SL relay?

8 – Nokia France

Q1: What is the motivation for considering putting the full gNB on the satellite?

Q2: For DSS between TN and NTN, where do you see regulations that support this?

2.2 Comments on Positioning [2]

Feedback Form 3: Comments/Questions on Positioning

1 – DanKook University

1) I support Fraunhofer's proposed objectives, in particular, the point that phase measurements for positioning should be studied in release-18.

2 – CATT

CATT supports the phase measurements for positioning.

Q1: Fingerprinting method is normally supported by the measurement of RF signals strength (e.g,, RSRP, RSSI, etc.). Since the measurements of RSRP is already supported in R16, we assume fingerprinting method can actually be supported by LMF with the use of RSRP measurements. What are additional works that needs to be done to support the fingerprinting method in Fraunhofer's view, e.g., adding new measurements, such as RSSI, SNIR, and/or introducing new positioning procedure for Fingerprinting positioning?

3 – ROBERT BOSCH GmbH

[Bosch] Bosch support 5G DL-PRS or Positioning Reference Devices (PRD) to reduce the total complexity of precise positioning. Question here:

- Do you think this is extendable to industrial domain? will we still achieve the high positioning requirement, latency, integrity/reliability, etc. ?
- We support RedCap device positioning; however, do you know a possible positioning accuracy range for the 20 MHz device? what about the proposed 10/5 MHz?

4 – Sony Europe B.V.

We also support positioning for RedCap UE.

1) There is NO low-power device yet in NR. What is low-power device? Is this a new device that has even more reduced capabilities than RedCap UE?

5 – Intel Corporation (UK) Ltd

Q1: Given that phase measurements per first arrival path are already being discussed in R17, please clarify whether phase measurement is expected to be a leftover from R17 or new design options are being considered e.g. carrier phase based solution?

Q2: For support positioning for low-power devices with advanced positioning capabilities, does that imply that we will define a new UE type? What's the different between this and RedCap?

6 – Beijing Xiaomi Mobile Software

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Q1: Do you think is there a need to define new accuracy requirement for RedCap positioning or just reuse the requirement defined for eMBB?

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Q2: Do you think is there a need to have a short study phase to clarify the requirement for RedCap and perform the evaluation to see if there is gap to reach that requirement?

7 – Huawei Tech.(UK) Co.. Ltd

Thank you for the contribution. Positioning Reference Devices are utilized as the anchors and the positioning UE has no connection to the gNB, so is it sidelink positioning scenario based on the PRD?

8 – LG Electronics Inc.

Q1: Regarding Low Power and Low Complexity positioning, could you explain difference between Rel-17 positioning reference device and Rel-18 PRD? In addition, could you explain more details or example ways to get advantages from network complexity perspective.

9 – Nokia France

Q1: What is the motivation to introduce reference devices for reducing network complexity, e.g. other than timing error mitigation?

Q2: Do you see architecture impacts or need for LMC (LMF in RAN) coming from high accuracy continuous tracking?

2.3 Comments on Sidelink Positioning [3]

General comments on sidelink positioning can be given here:

Feedback Form 4: Comments/Questions on Sidelink Positioning [3]

1 – CATT

In RWS-210322, Fraunhofer has proposed using phase measurements for positioning.

In our view, NR carrier-phase positioning may have specially application for SL positioning. For example, once one UE is phase-locked to another UE, any changes of the relative between the two UEs can be

monitored precisely from the change of the carrier phase measurements even without the need to resolve the integer ambiguity. What is Fraunhofer's view on supporting SL carrier-phase positioning?

2 – Beijing Xiaomi Mobile Software

1. Do you think the commercial and public safety use cases and requirements identified in SA1 Ranging WI(TR22.855/TS22.261) should be taken into account?

2. According to the definition and the KPI requirements of relative positioning and ranging in TS22.261(see below), do you agree that relative positioning and ranging are different, i.e. relative positioning requires to acquire the 2D/3D coordinates(e.g. the horizontal accuracy of relative positioning set requirements on both distance accuracy and angle accuracy) while Ranging requires to acquire only one component of 2D/3D coordinates(either distance or angle) and thereby only set requirements on one component(either distance or angle)?

- relative positioning: relative positioning is to estimate position relatively to other network elements or relatively to other UEs.

- Ranging: refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct communication connection.

3. Do you think unlicensed band should be considered? If so, what frequency range is considered(e.g. 60GHz)?

4. What bandwidth do you think is needed to acheive 10cm distance accuracy and 2 degree angle accuracy?

5. For in coverage case, do you think UE based SL-positioning should also be supported?

6. Do you think power consumption and Redcap UE should be taken into account?

3 – Sony Europe B.V.

We also support on sidelink positioning in Release-18 as indicated in our contribution RWS-210301.

1) Will there be any specification impact on the introduction of a UE with DAS?

2) Would Fraunhofer consider FR2 is equally important as FR1?

4 – Huawei Tech.(UK) Co.. Ltd

Q1: For internal Rx and Tx delays in the 1st objective, would it be a serious problem for SL AoA?

Q2: Rx and Tx timing error has been studied in R17 ePos, is there any difference here?

5 – Lenovo (Beijing) Ltd

Q1: In Page 3 on sidelink positioning on unlicensed band, currently sidelink on unlicensed band has not been supported. What's your view on how to handle sidelink communication on unlicensed band and sidelink positioning on unlicensed band in Rel18,e.g.,two parallel items or sidelink communication on unlicesed band with higher priority ?

6 – Nokia Denmark

It is also our proposal to include Sidelink ranging into Sidelink positioning, so sidelink RS enhancement is ok.
QUESTION: is UE-assisted positioning covering also partial coverage case?

2.3.1 Time-of-Flight based Ranging

Depending on bandwidth and channel conditions, Time-of-Flight measurements on the sidelink offer in-principle properties to support very high accuracy and path resolution in multipath scenarios.

Feedback Form 5: Do you support the introduction of a Time-of-Flight based ranging scheme (e.g. RTT) as a basic mechanism for sidelink positioning?

1 – Beijing Xiaomi Mobile Software Yes, both SS-TWR(single sided two way ranging) and DS-TWR(Double sided two way ranging) can be considered
2 – Huawei Tech.(UK) Co.. Ltd This phase of the workshop is Q&A, not agree to support/not support. Same comment for each other such question.

2.3.2 Additional Parameters

A Time-of-Flight based ranging scheme for positioning on the sidelink could be assisted by further parameters useful for positioning that can possibly be estimated on the sidelink like Angle-of-Departure, Angle-of-Arrival or RSRP.

Feedback Form 6: Do you support considering additional parameters (apart from ranging results) for positioning?

1 – Beijing Xiaomi Mobile Software Yes, we agree that Both AOA/AOD and RSRP/RSRQ can be considered. Besides, LOS identification and indication can also be supported. Other parameter exchange may also consider the capability exchange, accuracy requirement/bandwidth requirement, etc.

2.3.3 Distributed Antenna Systems

Vehicular Distributed Antenna Systems may improve the positioning performance such as accuracy, reliability and availability by offering different reference points on a vehicle and the possible ability to resolve angles.

Feedback Form 7: Do you support considering Distributed Antenna Systems for sidelink positioning?

1 – Beijing Xiaomi Mobile Software Can be considered

2.3.4 Frequency Ranges

Considering different frequency ranges (e.g. FR1, FR2, unlicensed bands) and their combinations:

Feedback Form 8: Do you support a generic and flexible design of sidelink positioning schemes for both FR1 and FR2 as well as for unlicensend bands?

1 – Beijing Xiaomi Mobile Software

Yes, for unlicensed band, up to 71 GHz can be considered. We can also consider supporting control signalling sent over licensed band, and Ranging signal over unlicensed band

2.4 Comments on IoT Topics [4]

General comments on IoT / RedCap / Power saving related topics can be given here:

Feedback Form 9: Comments/Questions on IoT / RedCap / Power Saving Topics

1 – Sony Europe B.V.

In your T-doc RWS-210324, you proposed in Slide 5, you have a proposal on low-latency HARQ:

Low-latency HARQ to improve spectral efficiency

- *Early HARQ feedback to reduce the HARQ RTT*

How is Early HARQ-ACK feedback achieved, is this a proposal for new UE processing capability for HARQ RTT reduction?

2 – Classon Consulting

[for FUTUREWEI]
Early HARQ feedback is also helpful in meeting stringent survival time requirements.

3 – ROBERT BOSCH GmbH

[Bosch]: We fully support smaller bandwidth for RedCap devices (however, we may limit it to 5 MHz in this release). In this case:

- Do you support plurality of values [e.g., 5, 10 (in addition to 20)]? If yes, should this be configurable? or adaptive (e.g., digitally on BB and not RF)?
- Do you support smaller BW for RedCap also over sidelink (we are interested in 10 MHz in addition to the 20 MHz)
- For supporting IIoT/URLLC:
  - Do you support lower latency for RedCap in general? If yes, do you have in mind latency value/range for (at least) 20 MHz RedCap UEs?

- In addition to HARQ enhancements: Do you see further enhancements (with moderate power consumption/moderate BW requirements) for IIoT?

4 – Intel Corporation (UK) Ltd

Q1. What is your assumption on receiver structure, sensitivity for energy harvesting? Is this used with a wake-up radio like receiver?

Q2: Do you think AR/VR enhancements could be handled as part of further enhanced URLLC/IIOT or as part of standalone XR enhancements item?

Q3: For unlicensed URLLC/IIOT, do you consider enhancements to only FBE operation or LBE or both? What could be further enhanced?

5 – Spreadtrum Communications

Thanks for the nice contribution, for the RedCap part (slide 3), we have two questions:

1. Regarding the BW, would you please clarify the motivation for support of small bandwidths less than 5MHz? In our understanding, if the maximum BW is less than 5 MHz, the spec impacts would be very big, what's the benefit?

2. Regarding the use cases, we just wondering what else we need to specify for Redcap to support sparse MOD applications and LTE-M use cases? It reads like that the current RedCap cannot meet the requirements of those use cases.

6 – Apple GmbH

[Apple] Thank you for the overview in RWS-210324. Regarding the enhancements for IIoT (slide 2/4), we have two questions along similar lines as Intel.

Q1: As we know Rel-17 is already meant to support URLLC over NR-U. Could you elaborate on specific enhancements that you have in mind for enhanced URLLC support for IIoT/factory automation in unlicensed bands, or is this more targeting leftover items from Rel-17?

Q2: We understand AR/VR/XR could be used in industrial context also. Do you think such enhancements for AR/VR and enhancements to support XR cloud services could be considered as part of the XR work item? Could you indicate more details on the type of XR enhancements envisioned?

7 – Sony Europe B.V.

[in addition to the Sony question posted above...]

Slide 3: What is a "sparse MOD application"?

Slide 4: what aspects of energy harvesting are you considering? Is it just that the device has low energy reserves or is it that the energy available is intermittent?

Slide 6: Other than for IoT-NTN, we are not envisioning an NB-IoT WI in Rel-18 as we think that there should be time for the market to catch up with already specified features. However, do you think that CB-PUR would also be applicable to eMTC?

8 – LG Electronics Inc.

Thanks for the contribution. We have the following questions.

1) Regarding low-latency HARQ, Does it means both UL and DL HARQ procedure?

2) if low-latency HARQ include to DL HARQ procedure, Does this also include reduced processing time?

2.4.1 Enhancements for RedCap Devices

RedCap devices are considered for broadening the use of NR for IoT use cases without interfering with NB-IoT LPWAN applications. In addition to that, the relaxed requirements and the lower complexity of RedCap devices make them interesting for other use cases that have not yet been considered in the WID.

Feedback Form 10: Do you support to further reduce the minimum bandwidth required for a RedCap UE?

Feedback Form 11: What should be the minimum bandwidth for an LowBandwidth-RedCap (LB-RedCap) device?

RedCap devices should also support NR-U deployments, especially for industrial environments. The power saving techniques considered within the PowSav WID did not address RedCap devices specifically.

Feedback Form 12: Do you support RedCap-specific power saving enhancements in licensed and unlicensed (NR-U) bands?

2.4.2 Enhancements for Power Saving

Additional power saving enhancements have the potential to further broaden the use cases for 5G-NR. Besides the extension of battery lifetime, further and intelligent power saving technologies could even enable devices that (also) rely on energy harvesting.

We propose to work on power saving enhancements specifically for RRC_CONNECTED, due to the possible impact on network performance if reusing IDLE/INACTIVE methods.

Feedback Form 13: Do you support to include power saving enhancements for RRC$_{C}ONNECTEDinapossiblefutureePowSavWID, e.g.PDCCHmonitoringenhancemen$

Feedback Form 14: Do you support to consider energy harvesting devices in an upcoming ePowSav WID?

1 – Classon Consulting

[for FUTUREWEI]

Harvesting energy is interesting

2.4.3 NB-IoT Enhancements

NB-IoT is the 5G LPWAN technology and RAN agreed to not have another technology for LPWAN in 5G.

The advantages of a worldwide, managed, robust and secure NB-IoT LPWAN system are obvious. Nevertheless, there are plenty of competitors that also provide large scale LPWAN networks with considerably longer battery lifetimes and lower infrastructure costs.

There is a market for IoT devices that require a lower PER, have very relaxed latency constraints and require the possibility to have a lifetime of larger than 10 years. We propose two methods to enhance NB-IoT in order to be a true competitor for commercial LPWAN systems: Energy Harvesting and CB-PUR.

For energy harvesting with very limited battery capacity the eNB/gNB has to know about the constraints in order to allow enough time for the device to regain energy for the next transmission.

Feedback Form 15: Do you support to consider specific enhancements for energy harvesting NB-IoT devices?

Use cases with very relaxed requirements regarding reliability and latency a fully managed network requires a lot of headroom that is not related to the actual data transmission. In Rel-16 preconfigured uplink resources (PUS) have been discussed, either as dedicated PUR, contention-free PUR (CF-PUR) or contention-based PUR (CB-PUR). Our proposal is to consider supporting specific NB-IoT carriers where UEs can be configured to transmit without grants but in a slotted contention-based channel. Depending on the load and type of application (UE assisted information) the eNB/gNB could configure UEs to use these carriers, if capacity allows for it, and spare signalling.

Feedback Form 16: Do you support discussing CB-PUR in Rel-18 w.r.t NB-IoT/eMTC?

2.5 Comments on Sidelink [5]

The main focus areas of the sidelink features captured in [5] are advanced vehicular communications, industrial IoT and commercial communications. In this section, companies are encouraged to respond to the topics addressed in our contribution in [5] and put forth their questions and comments.

General comments on sidelink enhancements can be given here:

Feedback Form 17: General Comments/Questions on Sidelink Enhancements

1 – HuaWei Technologies Co.

Q1: Are the location-based features, e.g. RP-level, similar to the ”Zone” based configuration which was disucssed in Rel-16? If not, what is the difference?

2 – InterDigital Communications

Slide 5 suggests to study the possibility of using mIAB or relay nodes connected to gNB over Uu and SL (PC5). Can you elaborate on the benefits of this and what would be the use case of a relay node communicating over two different interfaces?

3 – Lenovo (Beijing) Ltd

On ”Support configuration of shared resource pools for increased resource efficiency” do you mean that one resource pool can be shared between Mode 1 NR UE and Mode 2 NR UE We think current spec can support this kind of configuration, or do you think further enhancement may be needed,e.g., sensing report of Mode 1 UE?

4 – CATT

What exactly is ”advanced SL DRX with location-based WUS/GTS”?

5 – vivo Communication Technology

Regarding the proposal of QoS enhancement, would you please elaborate a bit more on the issue and the potential solution? It seems currnet spec already supports UE reporting the QoS profile to network.

2.5.1 UE-Managed Centralized Sub-networks

UE-managed centralized networks are essentially managed by a manager UE or a coordinating UE which would be responsible for providing resource configurations and scheduling assistance to member UEs. This has applications in vehicular groups as well as in commercial in-house applications.

Feedback Form 18: Do you support the introduction of UE-managed centralized networks where one UE (lead or manager UE) can schedule other UEs? Would you support the feature for Mode 1, Mode 2 or both?

1 – ROBERT BOSCH GmbH

[Bosch]: we do support further enhancements to inter-UE coordination. In addition to automotive use cases, we also believe that some IIoT use cases may not be fully achieved without it, e.g., the cooperative carrying/ synchronized movement scenario in our TDoc RWS-210217 (which is also in TS 22.104)

In this case:

-

Question: In your opinion, what could be the enhancements needed on the top of Rel-17?

Regarding the supported Modes:

-

Answer: we believe it is possible for Mode 2 or a hybrid Mode (1/2) (which is more suitable for IIoT environment and/or unlic. bands).

2.5.2 Location-based UE Features

Due to the advent of IIoT and commercial use cases for sidelink, providing UEs with location-based resource configurations would enable seamless factory applications, while at the same time increasing power efficiency.

Feedback Form 19: Do you support the introduction of location-based UE features for the SL to enhance power saving?

1 – LG Electronics Inc.

Q1: Applications may trigger sidelink operations only when the UE stays in the area of interest. Is there some specific reason to do the location-based power saving operation in the radio layer?

2 – ROBERT BOSCH GmbH

[Bosch]: This feature is interesting to visualize and we generally support the direction. It is also meaningful for power saving.

In our understanding, what could be supported is when SL activation (e.g., of VRU) once the UE enters a traffic area. We are expecting the depicted Figure in [5] may have these two (but possibly joint) steps:

-

Step 1: the UE location-based service activates the SL (conveyed by higher layer)

-

Step 2: then the UEs adapt its sidelink DRX if it enters a V2X traffic area/zone (may be based on SL lower layer signalling)

Question: Do you confirm our understanding? If no, can you clarify a bit the proposed the solutions/ the layers impacted / etc.?

2.5.3 UE-to-UE Relay

UE-to-UE relay improves the coverage, quality-of-service provisioning, e.g., in terms of reliability.

Feedback Form 20: Do you support the introduction of UE-to-UE Relay?

2.5.4 Vehicular Relays

The use of mobile vehicular relays is currently being discussed in SA1, where the relay on a vehicle can cater to passengers inside the vehicle, as well as to pedestrians around the vicinity of the vehicle. This would enabling end-to-end service continuity for mobility scenarios, applicable in public safety and commercial use

cases.

Feedback Form 21: Do you support vehicular relays to improve services for mobile groups? Should the solution be based on sidelink L2/L3 UE-to-Network relaying or on mIAB?

1 – ROBERT BOSCH GmbH

[Bosch] We support this feature. We have the following question additionally:

- Can you please clarify the differences options and use cases for UE-to-Network relaying and mIAB?
- UE-to-Network relaying (Sidelink) on mIAB (Uu) for in-vehicle relay: which one you suggest for automotive ?

2 – Volkswagen AG

Vehicular relays can enable new use cases. Could you explain the potential impacts of the options you listed for relaying use cases?

3 – Qualcomm Technologies Int

Is in-vehicle connectivity for passengers envisioned as a relay or would it also include sharing content locally within the vehicle?

2.5.5 Predictive QoS

Service continuity across cells and gNBs are important for cell-edge and high interference scenarios, which along with predictive QoS, would allow the pre-reservation of resources along routes as well as enable layered QoS flows.

Feedback Form 22: Do you support that RAN-based mechanism to introduce predictive QoS should be studied?

1 – Apple GmbH

2.5.6 Carrier Aggregation

Carrier aggregation can improve the use of fragmented V2X spectrum for high throughput applications, e.g., HD and XR content delivery.

Feedback Form 23: Do you support carrier aggregation on the NR sidelink?

1 – Volkswagen AG

Yes, non-contiguous carrier aggregation at FR1 is important. CA is one mechanism to enhance throughput and / or to increase the communication reliability. In particular the ITS designated spectrum at 5.9GHz might be fragmented in some regions.

3 [1st Round] Answers

3.1 Answers to NTN [1]

1 - Asia Pacific Telecom co. Ltd

We wonder how small BW (<5) we shall support for cube satellite deployment.

[Fraunhofer] Cubesats with a mass of 1 to 10 kg and an electrical power of a few tens of 10 W would require a significantly lower bandwidth for mMTC kind of applications. A detailed link budget will be required, similar to the analysis in TR .38.821.

2 - ESA

The list of features in RWS-210321 are supported by us. Luckily, most of them are also suggested and supported in other ”NTN enhancements” documents from many 3GPP companies. I would like to highlight some of your keywords not listed in other contributions of relevance for us: 1) Flexible BWP management to support beam-hopping satellite systems, 2) PAPR techniques and waveform improvements for energy efficient transmissions.

[Fraunhofer] Thanks, we would like to highlight these two items as well.

Energy efficient waveforms are important for achieving a throughput over NTN, which is similar to traditional satellite waveforms like DVB-S2X.

Flexible BWP management enables easier coexistence of NTN/TN. Please note as well RP-211253 on regulatory aspects of Ka-band spectrum.

3 - Intelsat

We agree with the list of enhancements in RWS-210321. We believe a study of the CU/DU split architecture is interesting, we also support a waveform study.

[Fraunhofer] Thanks, let us see, what can be approved for Rel-18.

4 - Inmarsat

We support the proposals from Fraunhofer, in particular waveform efficiency related enhancements (e.g. low-PAPR waveform support)- we should aim for parity (or better) than current state of the art satcom waveforms.Smaller bandwidth configurations and flexible BWP configurations are the second priority (can be

used for more flexible channelization and beam hopping).ISL with IAB support and NTN positioning are interesting areas as well.

[Fraunhofer] Indeed waveform efficiency is important, and the total degradation should be kept low in order to achieve a similar throughput as satellite waveforms. R1-1908996 gives some initial background on the topic.

5 - Intel Corporation (UK) Ltd

Q1: For DFT-s-OFDM waveform in DL, do you expect very large amount of work in RAN1?

Q2: Enabling NR NTN without GNSS at the UE will lead to decreased system performance due to larger PRACH reception window (especially for GEO) and frequent PRACH transmission (especially for LEO). Do you expect that significant part of connections will correspond to UEs without GNSS?

[Fraunhofer]

Q1: No, we believe that the standardization impact is limited, since DFT-s-OFDM it is already specified for the UL.

Q2: This is indeed an important item, where companies should comment on the market share they expect for the UEs w/o GNSS.

6 - CATT

We are pretty much aligned in several topics like support of Regenerative Arahitecture, coverage enhancement, Positioning enhancement, etc.

For CU-DU split option, maybe we could further work in the future release, and we could focus on the very basic case, full gNB on board case.

For indirect access,what's the scenario and use case? is it like UE access via CPE?

[Fraunhofer] For the split option, of course a full gNB on board has less latency than a deployment with CU on ground and DU on board of a satellite. Nevertheless we should consider both split options for Rel-18, which enables more flexibility in deployment options, depending on the capability of the space segment.

The indirect access we see more relevant in higher frequency bands above 10 GHz, where a high-gain antenna or a tracking antenna for NGSO is required for NTN. In this case, this special NTN-UE can connect via SL to terrestrial UEs.

7 - Sony Corporation

Thanks for the contribution. We have a question.

"*Enable access by terrestrial UEs via SL to NTN-enabled UEs*"Is the proposal for sidelink relay? How is this different to R17 SL relay?

[Fraunhofer] Similar answer as for the question by CATT. We see the possibility to leverage/re-use Rel-17 work on SL relaying, where Rel-18 specifies support of a NTN enabled UE connects to satellite, and further UEs connected via SL.

8 - Nokia France

Q1: What is the motivation for considering putting the full gNB on the satellite?

Q2: For DSS between TN and NTN, where do you see regulations that support this?

[Fraunhofer]

Q1: There is progress in satellite technology, enabling enhanced signal processing in the payload and thus see it natural, to not limit the 5G-NTN architecture to only a gNB-DU on board of a satellite. Considering a complete gNB and even edge computing is feasible in a regenerative payload with current technologies with the benefit of a reduced latency.

As an example, Fraunhofer develops an On-Board processor for up to 450 MHz bandwidth, which will be launched on an experimental satellite: https://www.iis.fraunhofer.de/en/ff/kom/satkom/obp/fobp.html.

Q2: As stated above, the ITU Radio Regulations and regionally (FCC, CEPT…) define the possible bands for satcom and terrestrial mobile services. RP-211253 gives some background information on regulatory aspects.

3.2 Answers to NR Positioning [2]

1 - On fingerprinting (CATT)

[Fraunhofer] Rel-16 positioning measurements and methods (such as DL-AoD) can be applied for fingerprinting methods. The procedure, when considering multi-antenna UEs within a multi-TRP scenario, needs further considerations in Rel-18. The motivation for defining a new method depends on whether the procedure of fingerprinting can be achieved with other Rel-16 methods. Depending on Rel-17 progress, additional reporting can be needed to support advanced fingerprinting approaches (such as CIR).

2 - On DL-RPS via PRD (Bosch)

[Fraunhofer] It is definitely applicable to the industry domain. We see that the impact on accuracy, latency, and reliability/integrity depends on the configuration, architecture and procedures. Therefore, this should be studied in relevant WGs. Our view is that the PRDs are enhancements that enable the network to support higher requirements on accuracy, latency and reliability.

3 - On REDCAP positioning accuracy (Bosch)

[Fraunhofer] We think that the positioning accuracy targets for REDCAP devices for the bandwidths under discussion should be jointly discussed in RAN/RAN1.

4 - On low power devices (Sony, Intel)

[Fraunhofer] The low power device in this context was used to motivate the scenario, representing for example a machine-centric battery-powered device in IIOT.

5 - Phase measurements (Q1 of Intel)

[Fraunhofer] Rel-17 is discussing phase measurements for DL-AoD enhancements and NLOS/multipath mitigation. Primarily, we consider phase measurements as key enhancements for UL and DL-TDoA to

achieve the cm-level accuracy which can build on the Rel-17 progress.

6 - Positioning requirements for REDCAP devices (Xiaomi)

[Fraunhofer] We should check whether a subset of the existing positioning requirements can be adopted to REDCAP, We think that the requirements, as defined by SA1, do not clearly distinguish between REDCAP and NON-REDCAP devices, but the achievable and targeted service levels need to be agreed upon in the RAN working group. On Q2, this is more of a question to the group in RAN and depends on the selected performance targets.

7 - PRD for SL positioning (Huawei)

[Fraunhofer] Depending on the PRD functionality, sidelink can be an option.

8 - Network Complexity (Nokia France/ LG)

[Fraunhofer] Rel. 18 PRDs support simplified synchronization and self-calibrated networks. In a different context, devices such as PRDs can be used to enable low complexity positioning methods such as fingerprinting (similar to RSRP based beacon systems).

9 - LMF in RAN (Nokia France)

[Fraunhofer] Possible impact should be subject for further study.

3.3 Answers to Sidelink Positioning [3]

1 - Carrier phase assisted SL positioning (CATT)

[Fraunhofer] We think SL positioning should be agreed and carrier-phase-based mechanisms may be considered. These of course need discussion.

2 - Questions from Xiaomi

[Fraunhofer]

1) Yes. SA1 requirements need to be considered.

2) With regard to definition of terms, we are open to clarify the meaning of ”relative positioning” vs. ”ranging”. Ranging may be a 1-dimensional distance measurement contributing to a 2D/3D relative positioning result.The offered definitions in the question are something we can agree to.

3) Unlicensed bands should be considered. We are in favor of a generic scalable SL positioning solution that supports different frequency ranges, bands and bandwidths.

4) Reaching performance targets of down to 10 cm depends on scenarios, parameter sets (including bandwidth) and possible hybrid use of positioning methods. This should be a joint discussion.

5) For in-coverage scenarios SL-positioning continues to offer unique properties that are beneficial. SL positioning should be considered for in-coverage scenarios.

6) Power consumption and RedCap devices can be taken into account, based on the application scenarios (e.g. V2X and public safety), the UE type and UE capability, which should be jointly discussed.

3 - DAS and FR 2 (Sony)

[Fraunhofer] It is possible that the support of UEs with DAS for SL positioning has specification impact. On FR2 for SL positioning: We are in favour of a generic and scalable SL positioning solution that supports different frequency ranges, bands and bandwidths.

4 - Rx/Tx Delays (Huawei)

[Fraunhofer] Rx/Tx Delays: In principle, we see the Rx/Tx delays in the context of the time-based methods, impact on a possible AoD detection can be discussed. It may be discussed, if there is additional impact on the Rx/Tx delays (adding to R17 ePOS), for example when considering different conditions, e.g. DAS of the vehicles.

5 - SL communications and positioning in unlicensed bands (Lenovo)

[Fraunhofer] As the ITS band as an unlicensed band (TS 38.101-1 Tabel 5.2-1) supports sidelink communication, also sidelink positioning should also be supported on the ITS band for Rel-18. In case any further unlicensed bands are supported in Rel-18, both sidelink communication and positioning should equally be supported.

6 - Partial-coverage scenario (Nokia Denmark)

[Fraunhofer] In our view, the SL positioning solution should address in-coverage, partial coverage and out-of-coverage scenarios.

3.4 Answers to IoT Topics [4]

1 - Reply to Sony (part 1):

[Fraunhofer] We propose to focus on solutions which enable predicting HARQ feedback in DL rather than introducing a new UE processing capability. The UE can estimate the probability with which it can decode a PDSCH based on channel estimation, partial decoding, etc. This kind of feedback is available at the UE even before the whole PDSCH is received and thus can be reported significantly earlier than any new UE processing capability and thus, the gNB can decide at an earlier stage whether retransmissions are required or not which results in a reduced HARQ RTT.

2 - Reply to Sony (part 2):

[Fraunhofer]

Q1: Sparse MOD application MOD in this context is Mobile-Originated-Data and defines an application that is to a very large degree sending data but receives data very rarely. Sparse means the reporting interval (if regular) or the time between data transmissions is very long compared to the amount of data and/or active transmission time. A typical use case is an event driven sensor or a sensor that has a long reporting interval and very little data to send.

Q2: Energy Harvesting

We are not sure whether we understood the question correctly. We would like to consider all aspects of energy harvesting. Energy harvesting could help both in the case that the UE has low energy reserves in general and also in a possible scenario where the UE only has intermittent power supply without energy harvesting.

Q3: NB-IoT

As PUR is also available for eMTC, CB-PUR can benefit eMTC use cases as well. NB-IoT still has a significantly higher energy consumption compared to other (regional or local) LPWAN solutions. To narrow the gap and open up new market opportunities, NB-IoT can be extended with a CB-PUR transmission scheme.

3 - Reply to CLASSON/FUTUREWEI:

[Fraunhofer] Yes, we agree.

4 - Reply to BOSCH:

[Fraunhofer] We think it would be beneficial to have UE supporting a maximum bandwidth of 5 MHz, 10 MHz, and maybe other bandwidths smaller than 20 MHz. In case we focus first on the standardization of UEs supporting only 5 MHz, the same mechanisms could be applied for any UE supporting a higher maximum bandwidth up to 20 MHz.

In our opinion smaller BW for SL should also be considered.

The current latency requirements in the WID are below 100ms for industrial wireless sensors and between 5-10ms for safety related sensors (end-to-end-delay). We think these requirements are in general fine. Regarding IIOT use cases, low bandwidth devices may have difficulty reaching sub 10ms latency with a very high reliability.

5 - Reply to Intel:

[Fraunhofer]

Q1: Energy Harvesting

Energy harvesting and wake-up receivers are two distinct things that should be considered separately. However, both can be combined appropriately.

Energy harvesting is based on a rectifier-based circuit that can provide a device with power that has been harvested from its surroundings. There are different sources to harvest energy (solar power, vibrations, radio waves, temperature gradients, etc.). Harvesting energy from the radio signal requires high signal strength at UE antenna port to drive a rectifier circuit. We expect around -40… -20 dBm at least. Depending on the UE design, energy harvesting can be used to extend battery lifetime, charge a buffer battery for peak power consumption or to fully drive the module via a capacitor.

Wake-up receivers are radio receivers that detect signals that contain a certain wake-up sequence while consuming an extremely low amount of power. After receiving the appropriate wake-up signal, this receiver can wake up the main circuit of the device from a (deep) sleep mode.

Using energy harvesting to power a dedicated wake-up receiver with extremely low power consumption that is then used to activate the module itself is one possible approach we are open to discuss.

Q2: AR/VR

We do not have a preference on whether XR should be treated separately or in a URLLC/IIOT WID.

Q3: Unlicensed IIOT

For unlicensed, immediate HARQ feedback within a UE COT contributes to a significantly reduced latency and hence, should be supported. In combination with further early HARQ enhancements, we believe that this can be achieved.

6 - Reply to Spreadtrum:

[Fraunhofer] Our main motivation to reduce the bandwidth is the IWSN use case where cost and battery lifetime are essential. For this use case, 5MHz is a good compromise. In addition to that, RedCap devices with a bandwidth of less than 5MHz are interesting for NR NTN and specific NPN networks with less than 5MHz dedicated spectrum, i.e. GSM-R (4MHz).

7 - Reply to Apple:

[Fraunhofer]

Q1: URLLC NR-U

Yes, Rel-17 URLLC does support unlicensed. We are considering further enhancements to enhance HARQ feedback to achieve a lower latency, see answer to Intel.

Q2: XR industrial

We think AR/VR will be used in industrial/commercial/professional training environments in the first place. Consumer applications (gaming, leisure) are used in a lot of justifications, but content creation for AR comes with quite a high costs. Cloud services in the sense of edge computing services within a campus network can decrease latency, ensure privacy and are relevant for a multitude of applications (IIOT and XR). We do not have a preference on where to include this objective.

8 - Reply to LG Electronics:

[Fraunhofer] Please refer to the answer to Sony for more details.

3.5 Answers to Sidelink [5]

Feedback Form 17: General Comments/Questions on Sidelink Enhancements

1 – HuaWei Technologies Co.

Q1: Are the location-based features, e.g. RP-level, similar to the ”Zone” based configuration which was discussed in Rel-16? If not, what is the difference?

[Fraunhofer] The location-based features are essentially on a functionality level, where, for example, a pedestrian UE does not have to be active on the SL resource pools when in-doors and away from any vehicular traffic. This is not on an RP-level, but instead the UE is expected to restrict its SL functionality based on its location. This would result in power saving gains, especially for P-UEs that are power-constrained devices. This can be further expanded to IIoT use cases, where certain UEs can be configured with different

functionalities based on their location on the factory floor.

2 – InterDigital Communications

Slide 5 suggests to study the possibility of using mIAB or relay nodes connected to gNB over Uu and SL (PC5). Can you elaborate on the benefits of this and what would be the use case of a relay node communicating over two different interfaces?

[Fraunhofer] The use of mIAB or enhanced relay nodes would enable UEs to be connected to the gNB over a transparent interface. It would be connected to the gNB via the Uu interface, and then connect with the UEs via the SL PC5 interface. The node itself can be used to relay configurations and information to the UEs, or simply act as a SL-enabled UE on its own. The current UE-to-N SL relay nodes are not really transparent to the UEs, while the current IAB nodes do not support the SL functionality. This would enable both coverage and capacity extension, as described in the currently on-going VMR SI in SA1. Which relaying solution is from your perspective the most convenient one for the VMR use case?

3 – Lenovo (Beijing) Ltd

On ”Support configuration of shared resource pools for increased resource efficiency” do you mean that one resource pool can be shared between Mode 1 NR UE and Mode 2 NR UE? We think current spec can support this kind of configuration, or do you think further enhancement may be needed, e.g., sensing report of Mode 1 UE?

[Fraunhofer] The current specifications define separate resource pools for Mode 1 and Mode 2, however, it is up to the discretion of the operator/gNB to configure these resource pools in shared or orthogonal resources. Due to the overall restrictions on bandwidth available to operators, it makes sense to provide support for shared pools among the modes, for which sensing reports are one of the essential features to ensure a collision-free system. Are there any other features that are required, from your perspective, to enable efficient mixed-mode resource pools?

4 – CATT

What exactly is ”advanced SL DRX with location-based WUS/GTS”?

[Fraunhofer] Our proposal is regarding the implementation of WUS/GTS in certain locations where the UE is expected to receive these signals, like in the case of automated valet parking.

5 – vivo Communication Technology

Regarding the proposal of QoS enhancement, would you please elaborate a bit more on the issue and the potential solution? It seems current spec already supports UE reporting the QoS profile to network.

[Fraunhofer] When a UE moves from one cell to another, the congestion status of the resource pools provided by each of the gNBs might differ, depending on the prevalent conditions. For example, a UE within the coverage of gNB1 might have been using a resource pool which is not congested, thereby enabling a higher QoS for its transmissions. But when the UE carries out a handover to gNB2 with resource pools that are heavily congested, the high QoS cannot be maintained. Currently, the UE has to retroactively adjust its QoS expectations accordingly.

We propose to use QoS prediction to maintain the UE’s QoS requirements based on the UE’s route.

Feedback Form 18: Do you support the introduction of UE-managed centralized networks where one

UE (lead or manager UE) can schedule other UEs? Would you support the feature for Mode 1, Mode 2 or both?

1 – ROBERT BOSCH GmbH

[Bosch]: we do support further enhancements to inter-UE coordination. In addition to automotive use cases, we also believe that some IIoT use cases may not be fully achieved without it, e.g., the cooperative carrying/ synchronized movement scenario in our TDoc RWS-210217 (which is also in TS 22.104)

In this case:

Question: In your opinion, what could be the enhancements needed on the top of Rel-17?

Regarding the supported Modes:

Answer: we believe it is possible for Mode 2 or a hybrid Mode (1/2) (which is more suitable for IIoT environment and/or unlic. bands).

[Fraunhofer] We agree with you that advanced inter-UE coordination is not confined to only automotive use cases, but to IIoT as well. On top of Rel-17, we propose the inclusion of a UE being able to schedule another UE, with or without the assistance of a gNB, where the manager or lead UE would provide resource configurations and schedule resources for transmissions to its member UEs. We are also open to exploring the possibility of a hybrid Mode 1/ Mode 2 option as well.

Feedback Form 19: Do you support the introduction of location-based UE features for the SL to enhance power saving?

1 – LG Electronics Inc.

Q1: Applications may trigger sidelink operations only when the UE stays in the area of interest. Is there some specific reason to do the location-based power saving operation in the radio layer?

[Fraunhofer] Having such operations on the radio layer would enable faster switching between functionalities that are defined for each of the locations where the UE is expected to operate. It would also benefit the UE in terms of power saving. Also see our response to Huawei above.

2 – ROBERT BOSCH GmbH

[Bosch]: This feature is interesting to visualize and we generally support the direction. It is also meaningful for power saving.

In our understanding, what could be supported is when SL activation (e.g., of VRU) once the UE enters a traffic area. We are expecting the depicted Figure in [5] may have these two (but possibly joint) steps:

Step 1: the UE location-based service activates the SL (conveyed by higher layer)

Step 2: then the UEs adapt its sidelink DRX if it enters a V2X traffic area/zone (may be based on SL lower layer signalling)

Question: Do you confirm our understanding? If no, can you clarify a bit the proposed the solutions/ the layers impacted / etc.?

[Fraunhofer] A UE can be (pre-)configured with location-based services beforehand, and when the UE is in a particular location/region, the UE would activate the associated services. However, lower layer signaling can also allow the alteration and dynamic configuration of these location-based services, which could be required for the support of emergency/public safety features.

Feedback Form 21: Do you support vehicular relays to improve services for mobile groups? Should the solution be based on sidelink L2/L3 UE-to-Network relaying or on mIAB?

1 – ROBERT BOSCH GmbH

[Bosch] We support this feature. We have the following question additionally:

Can you please clarify the differences options and use cases for UE-to-Network relaying and mIAB?

UE-to-Network relaying (Sidelink) on mIAB (Uu) for in-vehicle relay: which one you suggest for automotive?

[Fraunhofer] We do not have any preference at this moment, but would rather prefer that we study the pros and cons of each of the options, once we have defined the capabilities and objectives that are required to be performed by this node. Also refer to our answer to InterDigital above.

2 – Volkswagen AG

Vehicular relays can enable new use cases. Could you explain the potential impacts of the options you listed for relaying use cases?

[Fraunhofer] Vehicular relays would enable the support for both coverage and capacity extension use cases, as described in the currently on-going VMR SI in SA1, also refer to our answer to InterDigital above.

3 – Qualcomm Technologies Int

Is in-vehicle connectivity for passengers envisioned as a relay or would it also include sharing content locally within the vehicle?

[Fraunhofer] The in-vehicle connectivity would cover the case where the vehicle itself acts as a relay to the passengers within the vehicle. It can also enable the sharing of content among the passengers locally.

Feedback Form 22: Do you support that RAN-based mechanism to introduce predictive QoS should be studied?

1 - Apple GmbH

[Apple] Can you elaborate on the aspects and enhancements that you have in mind for predictive QoS? Also, is this meant in the context of handovers only, and does it include the Uu interface?

[Fraunhofer] Please refer to our answer to Vivo in section 2.5.

Feedback Form 23: Do you support carrier aggregation on the NR sidelink?

1 – Volkswagen AG

Yes, non-contiguous carrier aggregation at FR1 is important. CA is one mechanism to enhance throughput and / or to increase the communication reliability. In particular the ITS designated spectrum at 5.9GHz might be

fragmented in some regions.

[Fraunhofer] We agree with your comment.

4 [2nd Round] Comments/Questions

4.1 NTN [1]

Feedback Form 24: Comments/Questions in 2nd round on NTN [1]

1 – HuaWei Technologies Co.

Thanks for your answer. Do you think there will be specifciation impact, it seems a UE can anyway decide whether to receive or not depending on its UE implemenation or being configured to do specific operations. Do you think this would be a sufficient solution?

4.2 Positioning [2]

Feedback Form 25: Comments/Questions in 2nd round on Positioning [2]

1 – CATT

We share the similar view with Fraunhofer that in R18 there is need to have further improvements for high accuracy continuous tracking.

Q1: For the proposal: "Enable seamless positioning for mobility scenarios between positioning methods based on integrity and quality", should we assume that means UE/gNB are configured to support multiple positioning methods, then LMF will decide which methods to be used based on the UE/gNB measurements as described in Page 4? If that is the case, should it be already supported in R16/17? What are the additional enhancements needed?

Q2: For the proposal of "Increase efficiency of parallel tracking of many devices (reduce number of required REs, power consumption, overhead for assistance data delivery, overhead for power control and timing advance adjustment, etc.)", we assume the actions in the brackets are associated to accuracy/latency KPIs. Could Fraunhofer explain further how to achieve the goal of Increase efficiency without sacrificing the accuracy/latency KPIs?

4.3 Sidelink Positioning [3]

Feedback Form 26: Comments/Questions in 2nd round on Sidelink Positioning [3]

1 – Huawei Tech.(UK) Co.. Ltd

Thanks for the discussions. What is the motivation for considering only ranging in some of the proposed objectives?

2 – LG Electronics Inc.

Thank you for contribution. We also support SL positioning and DAS-based positioning.

Q1: Do you think that DAS can be used for both Uu link and SL based positioning?

4.4 IoT Topics [4]

Feedback Form 27: Comments/Questions in 2nd round on IoT [4]

1 – Spreadtrum Communications

Thank you for the valuable answers, we are interested in the lower bandwidth, for the point mentioned in your answers: "RedCap devices with a bandwidth of less than 5MHz are interesting for NR NTN and specific NPN networks with less than 5MHz dedicated spectrum, i.e. GSM-R (4MHz).", if possible, could you please share some reality information about the dedicated spectrum (less than 5MHz)?

2 – Sony Europe B.V.

Thanks for your clarification on the "sparse MOD application" term. We would have understood "sparse MO data"…

We are still unclear about which aspects of energy harvesting you are interested in. From your answer to Intel, we understand that you are interested in harvesting energy from the incident radio wave. We tend to think that energy would be harvested from the environment (solar, wind, vibration) in many cases, if there is no requirement on device form factor, rather than the incident radio wave. We think that 3GPP would be concerned with the protocol implications of devices operating on harvested energy (which is in line with your statement in 2.4.3 that "For energy harvesting with very limited battery capacity the eN-B/gNB has to know about the constraints in order to allow enough time for the device to regain energy for the next transmission".

4.5 Sidelink [5]

Feedback Form 28: Comments/Questions in 2nd round on Sidelink [5]

5 [2nd Round] Answers

5.1 Answers to NR Positioning [2]

1 - CATT

[Fraunhofer]

Q1: Yes, LMF will decide on choice of methods. In Rel. 16, the UE can already have multiple positioning methods running concurrently to achieve hybrid positioning. However, for the LMF to choose the best method for the UE for a given criteria and at a given time, the integrity/quality-of-service framework that currently under discussion in Rel. 17 for GNSS needs to be extended to RAT-dependent techniques. The unified handling of positioning integrity using different positioning methods could be addressed in Release 18.

Q2: We fully agree on the requirement that the increase of efficiency shall not sacrifice the accuracy/latency KPIs. According to our opinion many UEs can share OFDM symbols or even REs. The resulting interference shall be taken into account for the analysis. In studies for release 16 and 17 the interference played no/minor role for the analysis.

For enhancements discussed in Rel-16 and Rel-17 such as CS-staggering, applying phase correction becomes critical to support a huge number of users. For mobility scenarios, the enhancements to reduce the overhead for assistance data delivery, overhead for power control and timing advance are not supposed to impact the accuracy. (The network shall be able to provide an updated configuration only if needed). With regard to the power consumption and required number of UL resource elements per UE, our analysis in Rel-17 SI shows that enhancements such as multi-port SRS can reduce the number of SRS configurations as well as the UE transmit power and in some cases improve the accuracy. “

5.2 Answers to Sidelink Positioning [3]

1 - Huawei Tech.(UK) Co.. Ltd

[Fraunhofer] We are open for discussing further mechanisms. The proposal of time-based ranging was derived based on the need of selected applications as a starting point for SL-positioning. Which relevant mechanisms are missing in Huawei’s view?

2 - LG Electronics Inc.

[Fraunhofer] In principle, yes, but this needs further discussion by companies if the benefit is seen for some or for all scenarios.

5.3 Answers to IoT Topics [4]

1 - Spreadtrum Communications

[Fraunhofer] GSM-R is an example that primarily runs with 4 MHz bandwidth. There are discussions to switch to wider bandwidths (e.g. discussions to use LTE). However, RedCap could be a possible successor technology that might allow using the already existing bandwidths if there is RedCap with maximum bandwidth lower than 5 MHz.

2 - Sony Europe B.V.

[Fraunhofer] We are interested in all aspects of energy harvesting. Our focus is on incident radio wave, solar power, vibrations and temperature gradients. As you mentioned, from 3GPP perspective protocol related enhancements have to be considered.

5.4 Answers to Sidelink [5]

1 – HuaWei Technologies Co., Ltd

[Fraunhofer] Currently, the PCF authorizes a UE to transmit using certain radio parameters, e.g., frequency bands, etc., while the UE is in a geographical area. We find this method quite static and limited for location-based features.

We propose to introduce a more dynamic system, where the UE, with the RP configurations for a given area, restricts its transmission to avoid power wastage once it detects that it is in a certain area, e.g., indoors. For this, we could either have this restriction introduced in the SIBs, or per RP configuration, while the actual restriction itself would be handled by the UE based on its location. The other option is for the configurations themselves to provide specific location-based features or restrictions. This could be used for IIoT applications, where IIoT-UEs need to be restricted to operate certain features based on their location within the company grounds only.

6 Summary

Fraunhofer submitted 5 contributions under agenda item 4.2 for non-eMBB, which included the topics NTN Enhancements, NR Positioning, Sidelink Positioning, IoT and Enhanced Sidelink Features.

For **NTN [1]**, most companies agreed with the enhanced features proposed in our Tdoc like flexible BWP management, PAPR reduction, UE without GNSS, regenerative payload and leveraging IAB and SL-relaying from Rel-17. The questions asked by companies mainly focused on deployment scenarios, e.g., DSS, share of UEs w/o GNSS, bandwidth for cubesats, as well as clarifications of details on these topics. Furthermore, the expected standardization effort was especially discussed for using DFT-s-OFDM in the NTN DL.

For **NR positioning [2]**, during the Q&A phase we discussed and saw interest in the following items: Phase measurements as an enhancement for the positioning methods is seen as a potential candidate to achieve the high accuracy and availability requirements. Enabling fingerprinting approaches as a low-complexity method and for supporting positioning in complex NLOS environments was discussed. The procedure and reporting required beyond Rel-16/17 features is one of the concerns to be addressed. Positioning for RedCap devices, also in the context of battery-power-constrained UEs, should be brought forward and the handling of performance targets was discussed. Reference devices such as PRD can serve for different purposes, e.g., PRS-beacon for timing or RSSI-based proximity, sync source, in order to be able to reduce network complexity. Clarification was provided on the seamless positioning as well as SRS enhancements beyond Rel-16, while no objections were raised.

For **sidelink positioning [3]**, to ensure highly accurate results, Time-of-Flight based ranging, which could be further enhanced with additional parameters, as well as the support of a Distributed Antenna System, were part of the discussion and should be considered. By pursuing a flexible and generic design for SL positioning, FR1, FR2 and unlicensed bands should be supported.

For **IoT-related topics [4]**, part of the discussion focused on energy harvesting, which could be an interesting topic to be considered for Rel-18. Here, we are open to all possible energy sources, e.g., solar power, vibrations, incident wave, temperature gradients. From a 3GPP perspective, protocol-related enhancements have to be addressed. It was also discussed whether energy harvesting and wake-up receivers (WUS) should be considered separately or combined in an appropriate manner. Furthermore, we provided further motivation for the topic of reduction of the maximum bandwidth for RedCap devices to < 5 MHz, which seems to be requested also by other companies.

For the contribution on **enhanced sidelink features [5],** discussions were centered on location-based UE features and vehicular relays. We feel that the inclusion of dynamic location-based features depends on the extent to which configurability is permitted and the ability to quickly switch between these configurations, which needs to be studied further. A study on the pros and cons of each identified option for vehicular relays, namely mIAB and UE-to-N relays, is required, based on the capabilities and objectives that are required to be performed by this node. Other topics that were discussed included the specification of UEs having the ability to schedule other UEs for enhanced resource efficiency, predictive QoS for better QoS expectation management and support for shared resource pools and carrier aggregation.

We fully support the inclusion of these topics for further discussions in Rel-18 and thank all participants for their valuable comments and questions.

7 References

[1] RWS-210321 NR NTN Enhancements for Rel-18

[2] RWS-210322 Views on NR Positioning for Rel-18

[3] RWS-210323 Support for Sidelink-Positioning in Rel-18

[4] RWS-210324 Views on Rel-18 IoT Topics

[5] RWS-210325 Enhanced Sidelink Features for Rel-18