RAN-R18-WS-non-eMBB-Huawei - Version 0.0.5

RAN

3GPP TSG RAN Rel-18 workshop RWS-210573

Electronic Meeting, June 28 – July 2, 2021

Source: Huawei

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

Agenda item: 4.2

Document for: Information

1 Introduction

Huawei and HiSilicon have provided the following Tdocs for non-eMBB-driven functionalities in Rel-18:

RWS-210439 5G-Advanced XR

RWS-210442 Complementary TDD and URLLC enhancements for NR

RWS-210443 NR LPHAP and other NR positioning enhancements

RWS-210444 REDCAP enhancements

RWS-210445 NR sidelink and V2X enhancements

RWS-210446 NR multicast broadcast enhancements

RWS-210453 Passive IoT for 5G-Advanced

RWS-210454 UE reliability

Questions and comments followed responses from Huawei and HiSilicon are collected in this document as per the deadlines provided by the RAN chair. Feedback forms will be opened and closed according to those deadlines.

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 [First round] Q&A

2.1 RWS-210439 5G-Advanced XR

Feedback Form 1: Comments and questions to RWS-210439

1 – Spreadtrum Communications

Shall the two transmission mechanisms (the E2E layered QoS mechanism and E2E frame level integrated transmission) be applied together?

2 – CATT

Thanks for sharing the idea of NR enhancement for XR. The proposals of end-to-end QoS management and integrated frame level transmission and XR KPI identification for XR specific traffic awareness at RAN are quite interesting. However, we believe the aspects of NR enhancements should be discussed and concluded in the working groups first during the XR study before further discussion of the scope of XR work item.

3 – Classon Consulting

[for FUTUREWEI]

We also think enhancements are needed in Rel-18 for application-oriented QoS control to support low/bounded latency high throughput transmission of XR data bursts. Please see RWS-210040 page 8 and NWM https://nwm-trial.etsi.org/#/documents/4751 .

4 – Beijing Xiaomi Mobile Software

Thank you for sharing the material. The proposed E2E layered QoS mechanism, E2D frame level integrated transmission, and XQI are very interesting. However, we agree that the discussion on detailed R18 XR work scope should wait until R17 XR study item makes conclusion on the benefit of enhancements. In addition, since the KPI discussion has already been included in the R17 XR study item scope, do we still need to discuss XQI in Rel-18 XR work item?

5 – LG Electronics Inc.

We think E2E layered QoS mechanism is important, and should be standardized in Rel-18. To support ”E2E layered QoS mechanism with single QoS flows”, what kind of enhancements do you expect? Could you elaborate more on this?

6 – China Unicom

Thanks for sharing this contibution on XR.

The E2E layered QoS mechanism is a valuable solution. What is the essential work on specifications if support multiple QoS flow?

If discuss on the definition of the metric of XQI, the XQI maybe discuss in SA4 as well as the cooperations with other RAN WGs. We can further discuss how to utilize XQI metrics and related parameters in R18.

7 – Guangdong OPPO Mobile Telecom.

SA led or RAN led?

8 – ROBERT BOSCH GmbH

For XR enhancements,

- Q1: does Huawei sees a need for a separate WI or can be included in other WIs, e.g., IIoT?
- Q2: do you see support for IIoT (e.g., for factory control and monitoring) ?
- Q3: do you support mobility enhancements (e.g., for ToD use cases) ?

9 – Apple Europe Limited

Thanks for the contribution. In your contribution, you have ”The non-transmitted part of an XR frame will be discarded at the transmitter if any part of the frame has lost or exceeded the frame delay budget.”, then how about part of an XR frame in transmission (e.g. the first or second transmission has failed), then what would be the solution? If the network capacity is a bottleneck, will some packet be discarded?

10 – Lenovo Information Technology

Basically, we support E2E QoS enhancement for XR.

For E2E layered QoS mechanism and E2E frame level integrated transmission, we suppose SA2 should be involved.

For the XR Quality Index, we think SA4 and SA5 should be involved. In Rel-17 QoE WI, QoE metric for XR is probably covered. What’s the difference or addition work compared with what we are discussing in R17 QoE WI.

11 – MediaTek Inc.

Thanks for the good contribution. We have some questions below to know more about the enhancements.

For E2E layered QoS mechanism to enhance the capacity, how well can CODEC handle this kind of layered QoS design? What’s the expected RAN capacity gain in 5G NR system with this E2E QoS?

For cross-layer enhancement, RAN1 can first conclude the benefit of RAN awareness of application and application awareness of RAN first (Ex. packet dropping, packet prioritization), and then the work can be led by SA4 since QoS requirements are currently under study in SA4. How is it planned to progress the work in SA4 and RAN for RAN awareness of application and application awareness of RAN?

For the RAN-layer XR KPI, is it intended to be reported to the application so the application can do a better job in service adaptation (or say for application awareness of RAN usage)?

12 – Intel Corporation (UK) Ltd

Could you clarify the usage/benefit of defining a new metric ”XR Quality Index (XQI)” which is mainly calculated based on NW related parameters?

2.1.1 Answers

Feedback Form 2: Answers from Huawei to questions and comments on RWS-210439

1 – HuaWei Technologies Co.

1 - Spreadtrum Communications

HW's Reply:

The proposed two transmission mechanisms can work well separately. Of course if they are applied together, more potential gains can be achieved.

2 – CATT

HW's Reply:

We think the Rel-17 study is mainly to identify the traffic model and conduct performance evaluation for XR services, and then Rel-18 can continue to specify the solutions according to Rel-17 output.

3 – Classon Consulting [for FUTUREWEI]

HW's Reply:

Thanks for the comments and sharing the material. We also see some value on QoS enhancements for XR services.

4 – Beijing Xiaomi Mobile Software

HW's Reply:

We think the Rel-17 study is mainly to identify the traffic model and conduct performance evaluation for XR services, and then Rel-18 can continue to specify the solutions according to Rel-17 output.

For the second comments, in R17 PER and PDB is mainly used for capacity evaluation, but they are not sufficient to evaluate user experience. The intention of XQI is mainly to consider the metric specifically for XR in RAN to reflect XR user experience.

5 - LG Electronics Inc.

HW's Reply:

To support "E2E layered QoS mechanism with single QoS flow", identification of importance of packets can be considered for subsequent RAN handling of different packets. On the other hand if the layered QoS mechanism is with multiple QoS flows, the association of these flows needs to be identified. These are used for the network to make more suitable scheduling to enhance the capacity. This work requires involvement of SA2 and SA4.

6 – China Unicom

HW's Reply:

To support the layered QoS mechanism is with multiple QoS flows, the association of these flows needs to be identified. These are used for the network to make more suitable scheduling to enhance the capacity. This work requires involvement of SA2 and SA4.

For definition of the metric of XQI, we agree with you that SA4 needs to be involved, maybe RAN QoE can be a good start with coordination with SA4.

7 – Guangdong OPPO Mobile Telecom.

HW's Reply:

We think this work is end to end and requires both RAN and SA to proceed in parallel. Whenever needed, coordination between RAN and SA can be done as usual. Nothing new here, as SL relay is a recent example on how RAN and SA work in parallel.

8- ROBERT BOSCH GmbH

HW's Reply:

Q1: We prefer to have a separate WI for XR since the traffic characteristics of XR and IIoT services may be different.

Q2: Not sure which aspects you are referring to factory control and monitoring, if the uplink throughput is your main consideration, we have relevant proposals in RWS-210436; if the large data rate with very low latency at the same time is your consideration, our solution on XR can be used for this case.

Q3: We think mobility enhancement is a generic enhancement, which is not specific to XR but XR can also be beneficial from this. We think better to discuss all mobility enhancements together.

9 – Apple Europe Limited

HW's Reply:

From our view, if some part of the XR frame has already been lost or exceeded the frame delay budget, to transmit the remaining parts does not make sense, and therefore the remaining non-transmitted part and the part in transmission of the XR frame can be discarded. The packets can also be discarded in case the capacity becomes a bottleneck, e.g. discarding the packets with lower QoS requirement or lower importance.

10 – Lenovo Information Technology

HW's Reply:

Thanks for your support. We agree with you that SA2 needs to be involved for E2E layered QoS mechanism and E2E frame level integrated transmission.

XQI mainly requires RAN and SA4 work. XQI focuses on the metric definition of RAN for user experience for XR, while the existing QoE is rather an E2E metric which are not specific to RAN.

For additional work, we think RAN QoE can be improved with coordination with SA4, defining XR specific parameters to reflect user experience.

11 – MediaTek Inc.

HW's Reply:

Q1: for a certain XR service, there can be multiple data streams e.g., I-frame and P-frame, FOV stream and omnidirectional stream, video and audio and even basic layer and enhancement layer supported by H.264/5 SHVC. These are already supported by XR video source encoding (e.g. H.264/5). Since different data streams have different QoS requirements, prioritizing the transmission of the more important stream is beneficial for expanding the capacity. Based on our initial evaluation results in Rel-17 study in R1-2105521, Such layered QoS scheme can improve the XR capacity by about 60% compared with existing mechanism under typical system evaluation.

Q2: for cross-layer enhancement, we see the cooperation between RAN and SA is needed. We think this work is end to end and requires both RAN and SA to proceed in parallel. Whenever needed, coordination between RAN and SA can be done as usual.

Q3: we think a KPI that can reflect the impact of network transmission on user experience in XR services is needed in RAN. It can be used for network planning and optimization or even scheduling.

12 – Intel Corporation (UK) Ltd

HW's Reply:

Regarding of XQI, it is a KPI in RAN which can reflect the impact of network transmission on XR user experience. With XQI in RAN, the following benefits can be achieved, e.g. network transmission impact on user experience can be better evaluated through this new KPI, measurable performance of XR/Cloud Gaming in operators' networks can be obtained and used for network planning and optimization.

2.2 RWS-210442 Complementary TDD and URLLC enhancements for NR

Feedback Form 3: Comments and questions to RWS-210442

1 – Sony Europe B.V.

On Proposal 3 suggesting fast & accurate CSI reporting, an example was given where interfering cell predict or pre-schedule its scheduling and inform the interfered UE. Can you clarify how this can be done fast if the interferer cell needs to send its pre-scheduled information to the interfered UE?

2 – China Telecommunications

For proposal 2 that only support half-duplex operation at the UE side while supporting simultaneous transmission and reception at gNB side for this case, can you give more clarification about "some collision handling rules for half-duplex UEs might need to be studied/specified", what is the collision to be handled?

3 – vivo Communication Technology

We are supportive on proposal 1, which allows retransmision to happen on a differrent carrier than the initial transmission

Proposal 2 seems to require full duplex type of operation at the UE side, is this the correct understanding? However, from our analyis, it is not feasible to support full duplex at the UE side due to insufficient Tx-Rx seperation. We wonder what device type do you have in mind and what would be the corresponding Tx-Rx seperation?

4 – CATT

Thanks Huawei for the proposals. We have the following questions for clarification.

1) For complementary TDD in inter-BWP on the single cell, does UE need to support multiple active BWPs on the same cell?

2) Can you elaborate how UE would use the information from interferer cell for CSI measurement and report?

3) For selective PDCP duplication/higher-layer redundancy, what enhancements on top of what is already available in R16/17 do you have in mind?

5 – Nokia Germany

-

On proposal 1, PDSCH / PUSCH re-tx carrier switching: There is a motivation, but this had been discussed in RAN1 before (e.g. during the Rel-16 SI phase). Impacts to HARQ-ACK feedback operation (e.g. for Type 1 / Type 3 CB – CC playing a role there) as well as gNB and UE implementation would need to be considered.

-

On proposal 2, intra-band complementary TDD: Should this be discussed as part of Rel-17 potential cross-link interference (CLI) or part of the Rel-18 full-duplex studies? Or do you see the need to discuss this as part of a potential Rel-18 URLLC/IIoT follow up WI.

-

On proposal 3, this proposal seems to advocate for interference measurement enhancements, targeting inter-cell interference measurements. It is not clear whether the aim is to change CSI measurement and/or reporting behaviour or to support new CSI quantities. In either case, similar to CSI enhancements for M-TRP and inter-cell beam management enhancements in Rel-17, isn't this aspect best handled in an eventual NR MIMO WI?

-

On proposal 4 – PDCCH enhancements: Do you envision any other enhancements than the mentioned MU-MIMO PDCCH operation with orthogonal DM-RS? Is this really a URLLC-specific problem? Note that this may jeopardize the PDCCH reliability.

-

On proposal 5, selective PDCP duplication: Other than survival time, which is already being studied in Rel-17, what is the motivation of introducing selective PDCP duplication when gNB-implementation is sufficient in most cases

6 – Apple Italia S.R.L.

Q1: For cross-CC HARQ retransmission, is there any evaluation that shows how much gain can be achieved? What is the expected specification impact? We think this can have big impact on both gNB and UE implementation from MAC perspective.

Q2: For complementary TDD configurations, the main issue seems to be the interference management issue for intra-band/inter-BWP, which is the same as full/flexible duplex. If it is to be discussed, it is better to be generic instead of URLLC specific, e.g. together with full/flexible duplex.

7 – Samsung Electronics Co.

-In terms of self-interefernce cancellation, we think complimentary TDD is quite similar as XDD and subband FD. We have one question for Figure 3, in ths figure, botton subband is used for UL heavy and upper subband is used for DL heavy, however, what is H's view on inter-operator cross-link handling if UL channel of neighboring operator used is located next to bottom subband?

- For the inter-band CA with compelementary TDD configuration (Proposal1, section 2.2.1), do you have any consideration about other interference source? e.g., CLI and inter-operator interference

- If the complementary TDD configuration is specified, what is H's view on RAN1 spec impact?

1. Given that NR supports dynamic timing indications for PDSCH/PUSCH and complementary TDD configurations is a deployment issue, why should the TDD configurations be complenatry?

2. What is the impact on higher layers and on HARQ process management from switching the cell of a TB transmission?

3. What is the need for CSI enhancements beyond the ones considered in Rel-17?

4. What is the reliability/robustness of PDCCH MU transmissions and what are the envisioned scenarios?

In addition, what features need to be enhaced for mobility?

8 – Intel Corporation (UK) Ltd

Q1: Why the complementary TDD configurations are more beneficial than FDD on these carriers, since the resulting operation is very similar and may already be available in principle?

Q2: On CSI, is not the pre-scheduling of interference and trying to utilize these measurement contradicting to each other? In this case gNB A tries to adapt the transmission parameters knowing what would be transmitted by gNB B, but there is no way to adapt the other way around.

Q3: Do you think support of finer aggregation levels and/or 2-stage DCI may be beneficial to improve PDCCH efficiency?

9 – LG Electronics Inc.

Q1: Regarding CSI enhancements, it seems similar to CSI scheme proposed in Rel-17 URLLC discussion. In the discussion, there were questions on feasibilty of scheduling prediction and we think it wasn't fully resolved. Could you elaborate the differences?

10 – Qualcomm Incorporated

With regards to the complimentary TDD configuration: why not configure one BWP, or one CC being fully uplink and the other one being fully downlink?

With regards to selective PDCP duplication: on which criterion some packets will be duplicated and some other packets not? Is there any gain in energy consumption at the UE or gNB side?

2.2.1 Answers

Feedback Form 4: Answers from Huawei to questions and comments on RWS-210442

1 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you very much for your question. Please find our reply as below:

Q1: On Proposal 3 suggesting fast & accurate CSI reporting, an example was given where interfering cell predict or pre-schedule its scheduling and inform the interfered UE. Can you clarify how this can be done fast if the interferer cell needs to send its pre-scheduled information to the interfered UE?

A1: Indicating pre-scheduling information is just an example for potential CSI enhancement, we are open to discuss other solutions also if it can make the interference measurement more accurate for URLLC transmission and thus improve the reliability and efficiency. An example for the pre-scheduling scheme can include the following aspects: 1) For interfering cell, when it needs to schedule PDSCH for eMBB in slot n, then it will transmit CSI-RS in slot n-k, where the value k can be some predefined value; 2) For the serving cell with URLLC UE, if UE measures CSI in slot n, then the serving cell needs to ensure schedule the data for URLLC in slot n + k. For scenario like factory automation, based on the traffic characteristic, it should be feasible to do the scheduling following this kind of pre-defined pattern, which can ensure that the inference measurement for the URLLC UE can reflect the real interference.

Thank you very much for your question. Please find our reply as below:

Q1: For proposal 2 that only support half-duplex operation at the UE side while supporting simultaneous transmission and reception at gNB side for this case, can you give more clarification about ”some collision handling rules for half-duplex UEs might need to be studied/specified”, what is the collision to be handled?

A1: Since different DL/UL configuration will be used on different serving cells from the same band or on different BWPs on the same serving cell, there will exist the case of DL on one cell while UL on the other cell, then for half-duplex UEs there is need to define how to handle the collision of DL and UL, taking into account the priority of the service.

Thank you very much for your question. Please find our reply as below:

Q1: Proposal 2 seems to require full duplex type of operation at the UE side, is this the correct understanding? However, from our analysis, it is not feasible to support full duplex at the UE side due to insufficient Tx-Rx separation. We wonder what device type do you have in mind and what would be the corresponding Tx-Rx separation?

A1: No, we also think it is better to support half-duplex UE as the first step. Whether/when to support full-duplex UEs need further study.

Thank you very much for your questions. Please find our reply as below:

Q1: For complementary TDD in inter-BWP on the single cell, does UE need to support multiple active BWPs on the same cell?

A1: The support of multiple active BWPs is the best from performance perspective. Alternatively keeping one active BWP with BWP switching can be considered also, with some potential way to reduce the BWP switching delay.

Q2: Can you elaborate how UE would use the information from interferer cell for CSI measurement and report?

A2: We are open to discuss any solution if it can make the interference measurement more accurate for URLLC transmission and thus improve the reliability and efficiency. An example for the scheme can include the following aspects: 1) For interfering cell, when it needs to schedule PDSCH for eMBB in slot n, then it will transmit CSI-RS in slot n-k, where the value k can be some predefined value; 2) For the serving cell with URLLC UE, if UE measures CSI in slot n, then the serving cell needs to ensure schedule the data for URLLC in slot n + k. For scenario like factory automation, based on the traffic characteristic, it should be feasible to do the scheduling following this kind of pre-defined pattern, which can ensure that the inference measurement for the URLLC UE can reflect the real interference.

Q3: For selective PDCP duplication/higher-layer redundancy, what enhancements on top of what is already available in R16/17 do you have in mind?

A3: For selective PDCP duplication, we consider it might be enhanced to be operated in a finer granularity, e.g. per packet, not necessarily on basis of DRB in case differentiate handling within a DRB is needed. For higher-layer redundancy, we consider the replicate data transfer over N3 tunnels for duplicated PDU sessions can be also dynamically enabled for a more efficient manner.

Thank you very much for your questions. Please find our reply as below:

Q1: On proposal 1, PDSCH / PUSCH re-tx carrier switching: There is a motivation, but this had been discussed in RAN1 before (e.g. during the Rel-16 SI phase). Impacts to HARQ-ACK feedback operation (e.g. for Type 1 / Type 3 CB – CC playing a role there) as well as gNB and UE implementation would need to be considered.

A1: Yes as you mentioned above the benefit is there. As to the impact, we can further study whether/how much impact on the gNB/UE implementation. As to the impact on Type 1 HARQ-ACK codebook, that is

usual business for new features and we can further discuss whether/how to enhance Type 1/3 codebook to support this feature.

Q2: On proposal 2, intra-band complementary TDD: Should this be discussed as part of Rel-17 potential cross-link interference (CLI) or part of the Rel-18 full-duplex studies? Or do you see the need to discuss this as part of a potential Rel-18 URLLC/IIoT follow up WI.

A2: Yes we agree that the target scenario for proposal 2 is similar as sub-band flexible duplex or xDD, and actually it can be considered as one case of sub-band flexible duplex with complementary TDD DL/UL configuration on different bands. From interference management perspective, it seems better to discuss these two aspect together. We are open where to include it, can see the potential contents for different SIs/WIs.

Q3: On proposal 3, this proposal seems to advocate for interference measurement enhancements, targeting inter-cell interference measurements. It is not clear whether the aim is to change CSI measurement and/or reporting behavior or to support new CSI quantities. In either case, similar to CSI enhancements for M-TRP and inter-cell beam management enhancements in Rel-17, isn't this aspect best handled in an eventual NR MIMO WI?

A3: An example for the scheme can include the following aspects: 1) For interfering cell, when it needs to schedule PDSCH for eMBB in slot n, then it will transmit CSI-RS in slot n-k, where the value k can be some predefined value; 2) For the serving cell with URLLC UE, if UE measures CSI in slot n, then the serving cell needs to ensure schedule the data for URLLC in slot n + k. For scenario like factory automation, based on the traffic characteristic, it should be feasible to do the scheduling following this kind of pre-defined pattern, which can ensure that the inference measurement for the URLLC UE can reflect the real interference. We are open on where to discuss this, but since it is mainly to improve the performance for URLLC UE, it seems more appropriate to be included in URLLC WI.

Q4: On proposal 4 – PDCCH enhancements: Do you envision any other enhancements than the mentioned MU-MIMO PDCCH operation with orthogonal DM-RS? Is this really a URLLC-specific problem? Note that this may jeopardize the PDCCH reliability.

A4: The main scenario in our mind is factory automation, where usually only small packets need to be transmitted with a large number of users, therefore it is expected that the capacity for PDCCH channel is an issue. We are actually open on the potential enhancement as long as it can solve the capacity issue, e.g. we can even consider smaller AL with careful design to ensure the reliability. As to MU-MIMO PDCCH, for sure it will be helpful from capacity perspective, we would need careful design to avoid impact on the reliability also as you mentioned.

Q5: On proposal 5, selective PDCP duplication: Other than survival time, which is already being studied in Rel-17, what is the motivation of introducing selective PDCP duplication when gNB-implementation is sufficient in most cases

A5: We consider selective PDCP duplication can be further operated in a finer granularity, e.g. per packet in case differentiate handling with a DRB is needed and it is for uplink. In this case, it is not feasible to rely on gNB implementation to cope with selective duplication on a packet basis.

Thank you very much for your questions. Please find our reply as below:

Q1: For cross-CC HARQ retransmission, is there any evaluation that shows how much gain can be achieved? What is the expected specification impact? We think this can have big impact on both gNB and UE implementation from MAC perspective.

A1: As shown in our paper RWS-210442, one obvious gain is latency. For example, for the use case we give in section 2.1 in our paper, with cross-cc HARQ retransmission then the latency can be reduced to 3.5ms to meet the requirement of the scenario, as shown in Figure 3. We can further study whether/how much impact on the gNB/UE implementation, and companies view on this are welcome also.

Q2: For complementary TDD configurations, the main issue seems to be the interference management issue for intra-band/inter-BWP, which is the same as full/flexible duplex. If it is to be discussed, it is better to be generic instead of URLLC specific, e.g. together with full/flexible duplex.

A2: Yes we agree that the target scenario for proposal 2 is similar as sub-band flexible duplex or xDD, and actually it can be considered as one case of sub-band flexible duplex with complementary TDD DL/UL configuration on different bands. From interference management perspective, it seems better to discuss these two aspect together. We are open where to include it, can see the potential contents for different SIs/WIs.

Thank you very much for your questions. Please find our reply as below:

Q1: In terms of self-interference cancellation, we think complimentary TDD is quite similar as XDD and subband FD. We have one question for Figure 3, in this figure, bottom subband is used for UL heavy and upper subband is used for DL heavy, however, what is H's view on inter-operator cross-link handling if UL channel of neighboring operator used is located next to bottom subband?

A1: Yes, from interference management perspective, complimentary TDD is quite similar as XDD and subband flexible duplex. Actually complementary TDD with intra-band case can be considered as one case of xDD with complementary TDD DL/UL configuration on different bands. As to the inter-operator cross-link handling issue, if it exists similar as xDD the upper subband and bottom subband can keep the same configuration as neighboring cell, while adjusting the configuration located in the middle subband to achieve complementary TDD.

Q2: For the inter-band CA with complementary TDD configuration (Proposal1, section 2.2.1), do you have any consideration about other interference source? e.g., CLI and inter-operator interference

A1: The CLI or inter-operator issue for inter-band is something not specific here, therefore we don't provide specific enhancements for this aspect here. It can be considered for general CLI or inter0operator interference enhancement if necessary.

Q3: If the complementary TDD configuration is specified, what is H's view on RAN1 spec impact?

A3: For complementary TDD with inter-band CA case, the expected specification impact is to enable flexible initial transmission and re-transmission on different serving cells from different bands with complementary TDD configurations. For complementary TDD with intra-band case, if it is feasible based on the study, one potential impact is on interference handling and another aspect is collision handling rules for half-duplex UEs. We are open to discuss the potential impact also.

Q4: Given that NR supports dynamic timing indications for PDSCH/PUSCH and complementary TDD configurations is a deployment issue, why should the TDD configurations be complementary?

A4: The configuration with complementary TDD is to achieve a FDD like latency while ensure higher spectral efficiency to support co-existence of eMBB and URLLC. Only with complementary TDD, then it is possible to ensure DL and/or UL available any time whenever needed, thus to ensure low latency. Meanwhile, as we analyzed in the paper, other potential way to reduce the latency, e.g. increasing the DL/UL switching point, may increase the overhead and thus result in low spectrum efficiency.

Q5: What is the impact on higher layers and on HARQ process management from switching the cell of a TB transmission?

A5: We understand there are some ways to enable cross-carrier HARQ retransmission by either a common HARQ entity or separate HARQ entity. We are open to discuss. But we prefer to minimize the MAC spec impact as long as the HARQ buffer handling across carriers is able to resolve the issue.

Q6: What is the need for CSI enhancements beyond the ones considered in Rel-17?

A6: So far it is not clear yet what will be specified in Rel-17 yet. We are thinking to introduce some enhancement reflecting more accurate status of interference. For example, the scheme can include the following aspects: 1) For interfering cell, when it needs to schedule PDSCH for eMBB in slot n, then it will transmit CSI-RS in slot n-k, where the value k can be some predefined value; 2) For the serving cell with URLLC UE, if UE measures CSI in slot n, then the serving cell needs to ensure schedule the data for URLLC in slot n + k. For scenario like factory automation, based on the traffic characteristic, it should be feasible to do the scheduling following this kind of pre-defined pattern, which can ensure that the inference measurement for the URLLC UE can reflect the real interference.

Q7: What is the reliability/robustness of PDCCH MU transmissions and what are the envisioned scenarios? In addition, what features need to be enhanced for mobility?

A7: The main scenario in our mind is factory automation, where usually only small packets need to be transmitted with a large number of users, therefore it is expected that the capacity for PDCCH channel is an issue. We are actually open on the potential enhancement as long as it can solve the capacity issue. As to MU-MIMO PDCCH, for sure it will be helpful from capacity perspective, we would need careful design to avoid impact on the reliability also. For mobility, so far we don't see URLLC-specific issue, and we believe there is discussion on mobility enhancement for general cases and thus more details can be discussed there.

Thank you very much for your questions. Please find our reply as below:

Q1: Why the complementary TDD configurations are more beneficial than FDD on these carriers, since the resulting operation is very similar and may already be available in principle?

A1: Firstly, the target scenario here is for TDD spectrum not FDD spectrum. Secondly, for TDD spectrum we may need to take co-existence with other operators into account also, in which case TDD configurations may have to be configured. The intention here is to maintain the co-existence and simultaneously use complementary TDD to achieve FDD-like latency and high spectral efficiency for support of eMBB and URLLC.

Q2: On CSI, is not the pre-scheduling of interference and trying to utilize these measurement contradicting to each other? In this case gNB A tries to adapt the transmission parameters knowing what would be transmitted by gNB B, but there is no way to adapt the other way around.

A2: We are open to discuss any solution if it can make the interference measurement more accurate for URLLC transmission and thus improve the reliability and efficiency. An example for the scheme can include the following aspects: 1) For interfering cell, when it needs to schedule PDSCH for eMBB in slot n, then it will transmit CSI-RS in slot n-k, where the value k can be some predefined value; 2) For the serving cell with URLLC UE, if UE measures CSI in slot n, then the serving cell needs to ensure schedule the data for URLLC in slot n + k. For scenario like factory automation, based on the traffic characteristic, it should be feasible to do the scheduling following this kind of pre-defined pattern, which can ensure that the inference measurement for the URLLC UE can reflect the real interference.

Q3: Do you think support of finer aggregation levels and/or 2-stage DCI may be beneficial to improve PDCCH efficiency?

A3: Yes we feel support of finer aggregation levels and/or 2-stage DCI may be beneficial also. We are open to discuss solutions that can solve the PDCCH capacity issue

Thank you very much for your questions. Please find our reply as below:

Q1: Regarding CSI enhancements, it seems similar to CSI scheme proposed in Rel-17 URLLC discussion. In the discussion, there were questions on feasibility of scheduling prediction and we think it wasn't fully resolved. Could you elaborate the differences?

A1: We are open to discuss any solution if it can make the interference measurement more accurate for URLLC transmission and thus improve the reliability and efficiency. An example for the scheme can include the following aspects: 1) For interfering cell, when it needs to schedule PDSCH for eMBB in slot n, then it will transmit CSI-RS in slot n-k, where the value k can be some predefined value; 2) For the serving cell with URLLC UE, if UE measures CSI in slot n, then the serving cell needs to ensure schedule the data for URLLC in slot n + k. For scenario like factory automation, based on the traffic characteristic, it should be feasible to do the scheduling following this kind of pre-defined pattern, which can ensure that the inference measurement for the URLLC UE can reflect the real interference.

Thank you very much for your questions. Please find our reply as below:

Q1: With regards to the complimentary TDD configuration: why not configure one BWP, or one CC being fully uplink and the other one being fully downlink?

A1: Firstly, the target scenario here is for TDD spectrum not FDD spectrum. Secondly, for TDD spectrum we may need to take co-existence with other operators into account also, in which case TDD configurations may have to be configured. The intention here is to maintain the co-existence and simultaneously use complementary TDD to achieve FDD-like latency and high spectral efficiency for support of eMBB and URLLC.

Q2 With regards to selective PDCP duplication: on which criterion some packets will be duplicated and some other packets not? Is there any gain in energy consumption at the UE or gNB side?

A2 We are open to discuss the criterion for selective duplication, and can take other topics involving the differentiating handling for a DRB into account when needed. There can be power gains at UE side for the uplink and at gNB side for the downlink.

2.3 RWS-210443 NR LPHAP and other NR positioning enhancements

Feedback Form 5: Comments and questions to RWS-210443

1 – CATT

CATT shares the similar view LPHAP should be studied in R18, and share the similar view that CA positioning can be studied in R18.

2 – China Unicom

Thanks for this contibution.

We support to study LPHAP in R18, and we have some concerns on "ultra-deep sleep" mode. What's the difference between "deep sleep" and "ultra-deep sleep"? What is the potential solutions if supporting "ultra-deep sleep" as well as a lower power consumption?

3 – Sony Europe B.V.

Generally we support on the continuation of the evolution of positioning to also include device efficiency aspect as in dicated in our contribution RWS-210301.

1) Does the introduction of LPHAP align with device efficiency as we discussed during ePos SI in rel-17?

2) In the legacy approach, we have positioning measurement gap for positioning. During measurement gap, the positioning BW is typically different than the active BWP BW. What is the "decoupled communication BW and positioning BW"? Is it something else?

3) On ultra-deep sleep mode, can it also be applied to other than positioning? It sounds like a feature that can be applied for other purposes (e.g, communication).

4 – ZTE Corporation

Thanks for the nice contribution. Please see our questions/comments below

(1) In Section 2.3.1 for decoupled communication bandwidth and positioning bandwidth: In our view, PRS bandwidth and regular communication bandwidth are independent in the existing specification since UE separately report the maximum PRS bandwidth via UE capability. So, what is the further enhancement for this proposal?

(2) Do you think sidelink positioning should also be considered in Rel-18 for positioning enhancement ? If so, which agenda is more suitable, V2X or positioning ? what about Redcap positioning ?

5 – Beijing Xiaomi Mobile Software

- The Rel-17 positioning can reach accuracy of 0.2m@90% for IIoT scenarios, and the stringent accuracy targets of Rel-18 LPHAP is 0.3m, we may only need to study how to reduce power consumption in Rel-18 LPHAP. So do you think what is the spec impact to support LPHAP?
- If the solution of Decoupled Communication and Positioning bandwidth is introduced for LPHAP, we think it is similar to current specification. What is the further enhancement?
- For the mobility enhancement, we think all cells in the same PA need to reserve positioning SRS resources for one UE, so it will lead to waste and lack of SRS resources.
- Do you think ranging based service (TR22.855/TS22.261) should be supported in Rel-18? What about Redcap positioning?

6 – Samsung Electronics Co.

1. Table 1 shows good gains for UWB, is it expected that LPHAP in Rel-18 will exceed these targets?

2. For "Decoupled communication bandwidth and positioning bandwidth", what is the major difference between this decouple and currently supported configured measurement gap, especially shown as in Fig.2.

3. What is the impact of positioning area (PA) on SRS resources management? E.g., if one UE moves with the same SRS configuration to another cell, would that impact the SRS assignment of UEs in the new cell?

7 – Intel Corporation (UK) Ltd

Q1: For LPHAP, should new UE type be defined? What's difference from RedCap UE?

Q2: Further clarification on what's Ultra-deep sleep mode, specifically and RAN impact; if there is any difference compared with eDRX specified for RedCap UE?

8 – LG Electronics Inc.

Q1: How can the positioning area, where the SRS configuration is maintained, be determined? Does it rely on geographical information or tracking cell information?

Q2: For Low Power High Accuracy Positioning, for clarification, if you think the details of operation that transmit/receive SRS/PRS through larger BW and transmit/receive other DL/UL channel though narrow BW, we would appreciate if you would give us the details of operation.

2.3.1 Answers

Feedback Form 6: Answers from Huawei to questions and comments on RWS-210443

1 – Huawei Tech.(UK) Co.. Ltd

Response to China Unicom

Thanks for the questions and comments.

By ultra-deep sleep we mean a device is almost complete power-off in such a state, which normally requires longer time (than 20ms assumed for the current deep sleep mode in TR 38.840) to wake up from such a state. The power consumption during the transit period also consumes the overall battery life, which renders the necessity of reducing the transit period via, e.g. simplified operation/protocol stack during wake-up.

Response to Sony

Thanks for the questions and comments.

Q1: Relationship with Rel-17 efficiency

With regard to question 1, the target use cases/scenarios for LPHAP are different from what we are doing in Rel-17. Yes Rel-17 has an objective regarding device efficiency which is helpful and the first step to LPHAP, but the features to be specified in Rel-17 are not sufficient to satisfy the use cases and requirements of LPHAP. This is also why SA1 started a new WI for this in the first place.

Q2: Relation with the MG based measurement for bandwidth decoupling.

With regard to question 2, we think that this decoupling is not only about configuration aspects, but also UE capability aspects. We think what SONY questioned is about configuration aspects, but more importantly, this decoupling would require the hardcoded UE architecture to support different bandwidths for communication and positioning. In this sense, the UE data buffer is not affected by the larger bandwidth support for positioning RS reception and transmission.

Q3: ultra-deep sleep

With regard to question 3, whether the ultra-deep sleep can be applicable to other purposes can be further studied. We are open to it. However, we are thinking it originates more from LPHAP which basically only

has request of positioning but no/few request of communication, so that a quite long battery life can be sustainable.

Response to ZTE

Thanks for the questions and comments.

Q1: Decoupling bandwidth and existing PRS bandwidth capability

With regard to question 1, it is true that UE may report different bandwidth support for communication (to gNB) and PRS (to LMF). However, the bandwidth of SRS is currently tied with UE channel bandwidth capability reported to the gNB, so the proposal is mainly for SRS. It is one aspect we are considering for reducing UE power consumption for UL and DL+UL positioning methods.

Q2: relationship with SL positioning and redcap positioning

With regard to question 2, which project to discuss it can be decided a bit later, on the basis of workload, and relationships between the requirements being targeted in Rel-18.

Response to Xiaomi

Thanks for the questions and comments.

Q1: Spec impact to support LPHAP and relation with Rel-17 positioning enhancements

With regard to question 1, we are open to the techniques meeting the requirements of LPHAP. At this stage, what in our mind regarding the spec impact to support LPHAP at least includes decoupling positioning bandwidth and communication and introducing the positioning area to allow SRS transmission in IDLE/INACTIVE state in case of cell reselection. Whether additional spec impact is needed for the new ultra-deep sleep state of the UE can be further discussed.

Q2: Decoupling bandwidth

With regarding question 2, our understanding is that the current spec supports different BW configurations for DL communication and DL positioning but may not for UL, since the bandwidth supported for SRS transmission is now tied with the UE UL channel bandwidth. Also, the decoupling bandwidth intends more to mean the capability of UE supporting different bandwidths for communication and positioning.

Q3: resource waste of SRS for positioning area

With regard to question 3, we are assuming the periodicity of SRS transmission for INACTIVE state can be rather long, i.e. we do not expect 40ms periodicity for SRS transmitted in INACTIVE state. As the result, the resources reserved for SRS can be rather fractional depending on such parameters and also the number of UEs. Also, it can be up to network a tradeoff between the benefits of low power consumption and resources efficiency.

Q4: Ranging based service and redcap positioning

With regard to question 4, we think ranging based is more related to the support of sidelink positioning in general. For Redcap positioning, our view is expressed in RWS-210444, where basically we think there are some scenarios demanding REDCAP UE to support positioning and some cases even require high positioning accuracy.

Response to Samsung

Thanks for the questions and comments.

Q1: LPHAP target (UWB)

For question 1, at least we hope NR positioning based on LPHAP could be competitive in terms of positioning accuracy and battery life.

Q2: Relation with the MG based measurement for bandwidth decoupling.

For question 2, we believe the major difference is on the assumption of UE capability, rather than the aspects of configuration, transmission, and reception. Basically, we are assuming UEs to support LPHAP are the ones that are not required to be capable of supporting the same bandwidth for communication as that for positioning for the purpose of reducing power consumption.

Q3: Impact of positioning area

For question 3, firstly, UE is not required to resume connection to the new cell to get the same/different SRS configuration because connection resumption will consume power. Secondly, the SRS assigned to the UEs will be maintained and be reserved within the cells of the PA, which means the SRS is not likely to be assigned to other UEs in any of the cells. The sizes of PA is up to network for a tradeoff of UE power consumption and SRS resources efficiency.

Response to Intel

Thanks for the questions and comments.

Q1: New UE type and difference from RedCap UE

For Q1, we are open to study whether a new UE type is defined or it is based on RedCap or eMBB UEs. REDCAP positioning and LPHAP have different requirements in our opinion and the discussion in this workshop may need to first focus on the use case and the corresponding requirements for REDCAP and LPHAP.

Q2: Impact in RAN on ultra-deep sleep and relation with eDRX

For Q2, eDRX is to extend the paging period for the UE in IDLE/INACTIVE state, while for ultra-deep sleep, we mean a device is almost complete power-off. We are thinking that it originates more from LPHAP use cases, which basically only have requests of positioning but no/few requests of communication, so that a quite long battery life can be sustainable. In general, on top of supporting eDRX, “ultra-deep sleep” can further reduce power consumption.

Response to LG Electronics

Thanks for the questions and comments.

Q1: Determination and maintenance of positioning area

For Q1: From spec impact perspective, it is the configuration from network. From execution perspective, the positioning area can be determined by the operators given the overall layout of positioning nodes, potential hearability of SRS, and interference management. It needs to consider the geographical information. We are not clear about the meaning of “tracking cell information”, and if means tracking area, we do not think they are strongly correlated.

Q2: Switching between communication and positioning operation

For Q2: We think there should be some switching time between communication and positioning for the UE to perform the RF retuning and bandwidth adaption, which is quite similar to UE performing DL measurements in the MG.

2.4 RWS-210444 REDCAP enhancements

Feedback Form 7: Comments and questions to RWS-210444

1 – Classon Consulting

FUTUREWEI supports studying redcap positioning, but should be in positioning not redcap

2 – vivo Communication Technology

Thanks for the contribution. we would like to ask following questions

1. In order to support LTE Cat1bis like NR redcap devices, do you think we can keep the 20MHz UE BW as in Rel-17 while further reduce the baseband capability such as the following, or do you think further reduced UE RF BW has to be done?

- Reduce peak data rate by scale factor (in LTE, restricting maximum TB size)
- Further reduce the maximum modulation order
- Reduce the maximum number of DCI blind detections
- Reduce the maximum number of HARQ processes
- Relax the timing relationships of HARQ procedures

2. For redcap positioning, what enhancement do you have in mind to achieve similar accuracy for 20MHz capable redcap UEs compared to the normal UEs with 100MHz BW capability? and do you think power consumption is important for redcap positioning?

3. What potential efficiency improvement solutions do you consider for redcap?

3 – MediaTek Inc.

Thank you for sharing your views. We share your view that accurate positioning should be supported by RedCap. However, we prefer that this topic is discussed in an associated positioning work item to have all the relevant experts in the same room.

We also have the following questions:

Q1: As highlighted by 3GPP in the Rel-17 discussions, economies of scale is an important factor for reducing cost. Has the impact of market fragmentation been taken into consideration when suggesting lower bandwidth operation? Also have the limited cost benefits associated with lower bandwidths as outlined in RWS-210313 and RWS-210409 been considered?

Q2: Could you explain in some more detail what efficiency improvements are needed for RedCap? Do you foresee any gaps to support multicast with RedCap in Rel-17?

4 – Sony Europe B.V.

Proposal 1: The proposal and discussion are interesting. What further cost / complexity reduction do you think is possible in Redcap, considering the output of the main Redcap SI?

Proposal 2: Comment: We also support to Study REDCAP based positioning to achieve high accuracy. Would HW consider accuracy enhancements to compensate reduced bandwidth in RedCap UE?

5 – Ericsson LM

Regarding further reduced UE bandwidth (RWS-210444), we would like to ask what potential UE cost reduction you expect from reduction from 20 MHz to 5-10 MHz? The estimates from CATT (RWS-210409) and Ericsson (RWS-210313) indicate that according to the established cost evaluation methodology (TR 38.875), there may not be a very significant further cost reduction compared to 20 MHz.

Also, regarding the potential UE power saving from further UE bandwidth reduction, we would like to ask what potential gain there might be from hardcoded UE bandwidth reduction to 5-10 MHz compared to what can be achieved from simply configuring the UE-specific bandwidth part to 5-10 MHz?

6 – ROBERT BOSCH GmbH

- Q1: If Huawei supports RedCap for, e.g., bicycles, do you support RedCap with sidelink for VRU / eBike scenarios?
- Q2: for sub-meter level positioning accuracy, which bandwidth should achieve such a range?
- Q3: for reduced BW, will we end up with some supported BWs, e.g., 5, 10, 15, and 20? or you would like support 20 and 5 only?

7 – Spreadtrum Communications

Thank you for the contribution and thanks for the summary of the potential ways to further reduce UE cost/complexity in NR, we are interested in cost reduction.

For the second bullet, e.g. reduce peak data rate by scale factor, we just wondering is the scale factor here refer to the scaling factor in current 38.306? If so, what else we can do in Rel.18 for scaling factor if the RedCap supports scaling factor reporting in Rel.17? Introduce smaller values in Rel.18?

For the sixth bullet, e.g. relax the timing relationships of HARQ procedures, do you mean only N1 need to be relaxed?

8 – Lenovo (Beijing) Ltd

Thanks Huawei for the contribution. We share the similar view to introduce further reduced cost/complexity RedCap devices. One question it seems 5MHz is the target BW for FR1, but do you expect BW reduction also for FR2, if so, what's the target BW in your mind?

9 – Xiaomi Communications

[Xiaomi] Thank you for the contribution. For the positioning part, what's your view on how to carry out it? Just directly go to the WI phase or have a short study phase to define the requirement and perform evaluation to see the gap to reach this requirement ? Furthermore, do you prefer to discuss the RedCap positioning in the RedCap project for positioning project ?

10 – CATT

Thanks for the contribution. We have the following comments/questions.

1. Further cost reduction due to reduced BW seems small but lead to market fragmentation and potential impact on initial access. How much cost/complexity reduction is expected by BW reduction smaller than 20MHz based on your evaluation?

2. If the UE BW is reduced to 5MHz, SSB with 30kHz SCS cannot be accommodated within 5MHz BW. Then there will be big spec/implementation impact. Otherwise if 30kHz SCS SSB is not supported, the usefulness in the real deployment is quite limited.

3. Relaxed processing time was dropped in Rel-17 due to marginal cost reduction but significant negative impact to network. What additional justification is found to pursue this in Rel-18?

11 – Qualcomm Incorporated

1) could you comment on the power consumption and complexity aspects of NB positioning to achieve sub-meter accuracy ?

12 – Samsung Electronics Co.

1. With 10MHz or 5MHz BW, how much additional cost reduction do you expect compared with current RedCap, and simple restriction,e.g. restrict BW for PDSCH or restrict TBS? In the annex A, it seems like SSB/CORESET 0 are expected to be reused, is this correct? However, for PDCCH in CORESET 0, the coverage might have more serious issue compared with 20MHz DL BW. Do you think some coverage recovery is expected?

2. What kind of necessary spec change had been identified to support Pos for Redcap?

3. What kind of technique is expected for further power saving for RedCap, e.g., ZP-WUS? why such techniques are specific to RedCap to be discussed in RedCap WI other than general power saving for all type of device?

13 – Apple Poland Sp. z.o.o.

<Apple> Thanks for the paper.

1) On positioning, it is interesting to know the objective in some designs, e.g. new positioning algorithms to meet the same requirement as non-Redcap UEs (RAN1 impacts) or just defining some missed requirement e.g. for 1 Rx device? (Mainly RAN4 impacts)

2) on 'efficiency improvement',Rel-17 SDT and multicast transmission maybe already support by Rel-17 Redcap UE optionally. What is the further enhancement here for Redcap?

2.4.1 Answers

Feedback Form 8: Answers from Huawei to questions and comments on RWS-210444

1 – Huawei Tech.(UK) Co.. Ltd

1 – Classon Consulting

Q: FUTUREWEI supports studying redcap positioning, but should be in positioning not redcap

A: Which project to discuss it can be decided a bit later, on the basis of workload, and relationships

between the requirements being targeted.

2 – vivo Communication Technology

Thanks for the contribution. we would like to ask following questions

Q1. In order to support LTE Cat1bis like NR redcap devices, do you think we can keep the 20MHz UE BWas in Rel-17 while further reduce the baseband capability such as the following, or do you think further reduced UE RF BW has to be done?

Reduce peak data rate by scale factor (in LTE, restricting maximum TB size)

Further reduce the maximum modulation order

Reduce the maximum number of DCI blind detections

Reduce the maximum number of HARQ processes

Relax the timing relationships of HARQ procedures

A1: Further reduced UE bandwidth is the most valuable choice according to Rel-17 RedCap study. The other parts that were considered in the SI or earlier in LTE would lead to smaller improvements in competitiveness of RedCap. NR air-interface has a quite flexible framework, it is good opportunity to reshape more use cases towards migration to NR.

Q2. For redcap positioning, what enhancement do you have in mind to achieve similar accuracy for 20MHzcapable redcap UEs compared to the normal UEs with 100MHz BW capability? and do you think power consumption is important for redcap positioning?

A2: The discussion for REDCAP positioning in general should start from the use cases and the requirements. We see some use cases request high accuracy. For such cases we think that it can be achieved by e.g. using frequency hopping to approach the 100 MHz BW accuracy. We think power consumption is also important for some use cases via the RedCap devices. However in general, we believe the power consumption of RedCap positioning should be considered in the design of LPHAP solutions.

Q3. What potential efficiency improvement solutions do you consider for redcap?

A3: RedCap has some specific IoT characteristics, e.g. supporting single Rx UE, potential antenna efficiency loss for small factor device, potential large volume connections etc., thus solutions for reducing resource occupation, e.g. overhead of DCI, could be considered. Such techniques should be lower priority than further complexity reduction and positioning.

3 – MediaTek Inc.

Thank you for sharing your views. We share your view that accurate positioning should be supported by RedCap. However, we prefer that this topic is discussed in an associated positioning work item to have all the relevant experts in the same room. We also have the following questions:

Q1: As highlighted by 3GPP in the Rel-17 discussions, economies of scale is an important factor for reducingcost. Hastheimpactofmarketfragmentationbeentakenintoconsiderationwhensuggestinglower bandwidth operation? Also have the limited cost benefits associated with lower bandwidths as outlined in RWS-210313 and RWS-210409 been considered?

A1: We do agree with the importance of cost reduction via long-term economies of scale. However, it is not clear whether and when Rel-17 RedCap can cost-efficiently take all mid-to-high IoT markets by economies of scale. On the other hand, we observe the market of mid-tier IoT with low-data rate is emerging in LTE which is clearly different from what R17 RedCap can enable in the near future. Experience shows that even though LTE can have large economies of scale, there not just one IoT UE for all uses. For your second question, we also see many other companies think lower bandwidths have meaningful cost benefits. Our estimation shows reduced bandwidth down to 5MHz could have further reduction from about 7% to 15% according to TR 38.875, depending on combination of

FDD/TDD and Rx number. One important point is that the methodology in the TR sets R15 eMBB UE as baseline of 100%, thus such further reduction would have meaningful benefits for the low date rate IoT market which is quite cost-sensitive in absolute price.

Q2: Could you explain in some more detail what efficiency improvements are needed for RedCap? Do you foresee any gaps to support multicast with RedCap in Rel-17?

A2: Refer to answer to vivo Q3 above. For the second part, we think supporting multicast would be sufficient for use cases like firmware OTA, etc. For those RedCap specific IoT characteristics, e.g. supporting single Rx UE, potential antenna efficiency loss for small factor device, multicast would also help, and solutions for reducing resource occupation e.g. overhead of DCI for unicast, could also be considered. Such techniques should be lower priority than further complexity reduction and positioning.

4 – Sony Europe B.V.

Proposal 1: The proposal and discussion are interesting. What further cost / complexity reduction do you think is possible in Redcap, considering the output of the main Redcap SI?

A1: Refer primarily to answer to MediaTek. Our estimation shows reduced bandwidth down to 5MHz could have further reduction from about 7% to 15% according to TR 38.875, depending on combination of FDD/TDD and Rx number. One important point is that the methodology in the TR sets R15 eMBB UE as baseline of 100%, thus such further reduction would have meaningful benefits for the low date rate IoT market which is quite cost-sensitive in absolute price. It could be a little more if a combination of different cost/complexity reduction methods applies.

Proposal 2: Comment: We also support to Study REDCAP based positioning to achieve high accuracy. Would HW consider accuracy enhancements to compensate reduced bandwidth in RedCap UE?

A2: For proposal 2, for some cases requiring high accuracy for RedCap UEs, we think that it can be achieved by e.g. using frequency hopping to approach the 100MHz BW accuracy.

5 – Ericsson LM

Regarding further reduced UE bandwidth (RWS-210444), we would like to ask what potential UE cost reduction you expect from reduction from 20 MHz to 5-10 MHz? The estimates from CATT (RWS-210409) and Ericsson (RWS-210313) indicate that according to the established cost evaluation methodology (TR 38.875), there may not be a very significant further cost reduction compared to 20 MHz.

A1: We also see many companies evaluate that lower bandwidths have meaningful cost benefits for that market. According to section 7 of TR 38.875, UE bandwidth reduction gives the most significant gain for each number of Rx. Our estimation shows reduced bandwidth down to 5MHz could have further reduction from about 7% to 15% according to TR 38.875, depending on combination of FDD/TDD and Rx number. One important point is that the methodology in the TR sets R15 eMBB UE as baseline of 100%, thus such further reduction would have meaningful benefits for the low date rate IoT market which is quite cost-sensitive in absolute price.

Also, regarding the potential UE power saving from further UE bandwidth reduction, we would like to ask what potential gain there might be from hardcoded UE bandwidth reduction to 5-10 MHz compared to what can be achieved from simply configuring the UE-specific bandwidth part to 5-10 MHz?

A2: We understand they should be similar in the case you mentioned, and the main reason for 5 MHz is cost saving. Our mention of lower power in our paper was mainly a reference to the UE coming from Rel-17 RedCap.

6 – ROBERT BOSCH GmbH

Q1: If Huawei supports RedCap for, e.g., bicycles, do you support RedCap with sidelink for VRU / eBike scenarios?

A1: The use of RedCap for Uu-based applications, and use for PC5-based applications are different technologies and use cases. This means we do not directly link them together as in the question, but we note other companies make this proposal.

Q2: for sub-meter level positioning accuracy, which bandwidth should achieve such a range?

A2: In general, we think 20 MHz is not sufficient, and we think 100 MHz, or at least equivalent to 100 MHz, should be considered.

Q3: for reduced BW, will we end up with some supported BWs, e.g., 5, 10, 15, and 20? or you would like support 20 and 5 only?

A3: The cost and power benefits are largest with 5 MHz. Whether to support other bandwidths may depend on the incremental workload, and whether there are chipset vendors expressing interest.

7 – Spreadtrum Communications

Thank you for the contribution and thanks for the summary of the potential ways to further reduce UE cost/complexity in NR, we are interested in cost reduction.

For the second bullet, e.g. reduce peak data rate by scale factor, we just wondering is the scale factor here refer to the scaling factor in current 38.306? If so, what else we can do in Rel.18 for scaling factor if the RedCap supports scaling factor reporting in Rel.17? Introduce smaller values in Rel.18?

For the sixth bullet, e.g. relax the timing relationships of HARQ procedures, do you mean only N1 need to be relaxed?

A1: In answer to both questions: Our intention is to reduce UE bandwidth down to 5 MHz as the biggest benefit. We listed the other bullet point as examples that might be (or have been) discussed, but they would have less impact on the complexity reduction of RedCap. BW reduction contributes most to the cost reduction thus should be done; other techniques can be considered as secondary.

8 – Lenovo (Beijing) Ltd

Thanks Huawei for the contribution. We share the similar view to introduce further reduced cost/complexity RedCap devices. One question it seems 5MHz is the target BW for FR1, but do you expect BW reduction also for FR2, if so, what's the target BW in your mind?

A1: We are interested to discuss FR2. If it is possible, existing minimum UE channel BW in the spec seems straightforward.

9 – Xiaomi Communications

[Xiaomi] Thank you for the contribution. For the positioning part, what's your view on how to carry out it? Just directly go to the WI phase or have a short study phase to define the requirement and perform evaluation to see the gap to reach this requirement ? Furthermore, do you prefer to discuss the RedCap positioning in the RedCap project for positioning project ?

A: Whether to have a study phase or go directly to normative work would really have to depend on what was eventually included in the scope for RedCap positioning. Which project to discuss it can be decided a bit later, on the basis of workload, and relationships between the requirements being targeted, and so on.

10 – CATT

Thanks for the contribution. We have the following comments/questions.

1. Further cost reduction due to reduced BW seems small but lead to market fragmentation and potentialimpact on initial access. How much cost/complexity reduction is expected by BW reduction smaller than 20MHz based on your evaluation?

A1: To save some NWM length, we refer to the above answers to MediaTek.

2. If the UE BW is reduced to 5MHz, SSB with 30kHz SCS cannot be accommodated within 5MHz BW.Then there will be big spec/implementation impact. Otherwise if 30kHz SCS SSB is not supported, the usefulness in the real deployment is quite limited.

A2: 30 kHz SCS case may require some study, but there is not necessarily big impact (e.g. there was discussion on a similar issue in R17 RedCap claiming an implementation based solution can be used in FR2).

Relaxed processing time was dropped in Rel-17 due to marginal cost reduction but significant negativeimpact to network. What additional justification is found to pursue this in Rel-18?

A3: Our paper does not propose relaxed processing time.

11 – Qualcomm Incorporated

1) could you comment on the power consumption and complexity aspects of NB positioning to achieve sub-meter accuracy ?

A1: Thanks for the question. We think that the sub-meter accuracy can be achieved by e.g. using frequency hopping to approach the 100MHz BW accuracy. The profile of power consumption and complexity depends on different methods.

12 – Samsung Electronics Co.

1. With 10MHz or 5MHz BW, how much additional cost reduction do you expect compared with currentRedCap, and simple restriction,e.g. restrict BW for PDSCH or restrict TBS? In the annex A, it seems like SSB/CORESET 0 are expected to be reused, is this correct? However, for PDCCH in CORESET 0, the coverage might have more serious issue compared with 20MHz DL BW. Do you think some coverage recovery is expected?

A1: To save some NWM length, we refer to the above answers to MediaTek.

The second part of this question appears to be intended for another paper.

2. What kind of necessary spec change had been identified to support Pos for Redcap?

A2: If we pursue the accuracy of 20MHz positioning, there isn't much to do. However, if we target higher accuracy, it can be approached via frequency hopping to approach the 100 MHz BW accuracy.

3. What kind of technique is expected for further power saving for RedCap, e.g., ZP-WUS? why such techniques are specific to RedCap to be discussed in RedCap WI other than general power saving for all type of device?

A3:This question appears to be intended for another paper.

13 – Apple Poland Sp. z.o.o.

Thanks for the paper.

1) On positioning, it is interesting to know the objective in some designs, e.g. new positioning algorithms to meet the same requirement as non-Redcap UEs (RAN1 impacts) or just defining some missed requirement e.g. for 1 Rx device? (Mainly RAN4 impacts)

A1: We target the higher accuracy for RedCap UEs, and we think that it can be achieved by e.g. using frequency hopping. This would be for RAN1 to study.

2) on 'efficiency improvement',Rel-17 SDT and multicast transmission maybe already support by Rel-17 Redcap UE optionally. What is the further enhancement here for Redcap?

A2: See above answers to vivo Q3. RedCap has some specific IoT characteristics e.g. supporting single Rx UE, potential antenna efficiency loss for small factor device, potential large volume connections etc., thus solutions in the way of reducing resource occupation e.g. overhead of DCI could be considered. Such techniques should be lower priority than further complexity reduction and positioning.

2.5 RWS-210445 NR sidelink and V2X enhancements

Feedback Form 9: Comments and questions to RWS-210445

1 – Classon Consulting

FUTUREWEI also supports sidelink unlicensed

2 – LG Electronics Inc.

Q1: Can you elaborate on the meaning of "under network control in mode 1" in Proposal 3? Does this mean that the scheduling is actually done at gNB and the UE relays sidelink grants to another UE?

Q2: On Proposal 8, which entity/layer will perform QoS prediction? And considering that Rel-16/17 support some report of sidelink related information, some examples would help in understanding the proposal better.

3 – Guangdong OPPO Mobile Telecom.

We also agree with most of the proposals. However, the scope may be ambitious for one release. For R18, what would be the order of importance / preference? Or just with the order of the proposals?

4 – Qualcomm Technologies Int

For NR/LTE Co-Channel Coexistence, would you be willing to accept a more dynamic mechanism to handle changing loads between NR and LTE?

5 – ROBERT BOSCH GmbH

- Q1: do you support SL for IIoT and RedCap ?
- Q2: for SL pQoS, is it only for Mode 1 ?

6 – CATT

Can you provide details of the envisioned MDT enhancement for Qos prediction, and effects (via simulation, if any)?

7 – Nokia Denmark

will it include enhanced SL QoS monitoring capabilities?

8 – Samsung Electronics Co.

Q1: Is it the correct understanding that the proposal of supporting sidelink operations over unlicensed spectrum up to 71 GHz targets both 5/6 GHz and 60 GHz unlicensed bands?

Q2: For proposal 1, regarding reuse of existing Uu physical layer framework, do you envision this to be only the NR-U (unlicensed) framework, or will it also include the NR Uu-licensed framework as well?

Q3: For proposal 1, can proposal 1 meet requirement(s) of AR/VR gamining?

Q4: For proposal 3, in Mode 1, gNB schedules UEs on PC5. If a UE is scheduling another UE, does this assume the scheduling UE automously determines SL resources, for the scheduled UE, or the resources are allocated by the gNB and relayed by the scheduling UE to the scheduled UE?

Q5: For SL Positionig, what is your view on SL positioning WI: Part of Rel-18 SL WI, part of Rel-18 Positioning WI, or a seperate WI?

Q6: For QoS prediction enhancement (Proposals 7 and 8), these proposlas are understood to enhance QoS related measurement for V2X like usage and sidelink. Are the proposals to be part of SON/MDT WI?

9 – Apple (UK) Limited

Thanks for the contribution. On Proposal 7 and 8, could you please elaborate more how the QoS prediction impacts Uu or sidelink?

10 – MediaTek Inc.

Thanks for the contribution. We would like to understand in relation to the FR1-assisted unlicensed sidelink on FR2, is the assisting FR1 spectrum assumed to be licensed, or do you contemplate FR1 SL-U assisting FR2 SL-U?

2.5.1 Answers

Feedback Form 10: Answers from Huawei to questions and comments on RWS-210445

1 – Huawei Tech.(UK) Co.. Ltd

1 – Classon Consulting

FUTUREWEI also supports sidelink unlicensed

Answer Thank you for the support. We hope it can allow sidelink to support multi-Gigabit/s services thanks to the wide available bandwidth of unlicensed band, particularly the 60 GHz band.

2 – LG Electronics Inc.

Q1: Can you elaborate on the meaning of "under network control in mode 1" in Proposal 3? Does this mean that the scheduling is actually done at gNB and the UE relays sidelink grants to another UE?

Answer Yes, as in mode 2d described in Rel-16, or with allowing the UE to decide how to allocate the resources granted from gNB.

Q2: On Proposal 8, which entity/layer will perform QoS prediction? And considering that Rel-16/17 support some report of sidelink related information, some examples would help in understanding the proposal better.

□Answer□ The sidelink prediction should take place at the network side, because a UE will not be able to collect enough information to make a proper prediction. For example, the sidelink report could be the QoS relevant information including throughput, latency, packet loss (packet reception ratio), etc., for unicast, broadcast and multicast.

3 – Guangdong OPPO Mobile Telecom.

We also agree with most of the proposals. However, the scope may be ambitious for one release. For R18, what would be the order of importance / preference? Or just with the order of the proposals?

□Answer□ We think sidelink over FR2-2 unlicensed can be prioritized first, given the strong need to maximize data rate to support multi-Gigabit/s services. Reliability enhancement is also important to support higher levels of automation for V2X use cases, which includes resource allocation enhancement (e.g. UE scheduling UE) and predictive QoS. Power saving enhancement can be by extension of existing Rel-17 power saving schemes and SL-DRX, which will manage its workload.

4 – Qualcomm Technologies Int

For NR/LTE Co-Channel Coexistence, would you be willing to accept a more dynamic mechanism to handle changing loads between NR and LTE?

□Answer□ In considering NR/LTE co-channel coexistence, our preference is based on resource pool configurations to allow co-channel coexistence. It may be possible for gNB to play a role to have more dynamic configurations on resources to be allocated separately to LTE-V and NR-V.

5 – ROBERT BOSCH GmbH

Q1: do you support SL for IIoT and RedCap ?

□Answer□ We are open to considering that sidelink can be used to support IIoT use cases. If time allows in Rel-18, it may also be possible to discuss SL RedCap. Further work on scenarios/use-cases it may target at is needed first.

Q2: for SL pQoS, is it only for Mode 1 ?

□Answer□ Mode 1 yes, but Mode 2 can also be supported if it is in-coverage, where the network can collect the sidelink report from UE and provide prediction result to UE in a separate (non-real time) process.

6 – CATT

Can you provide details of the envisioned MDT enhancement for Qos prediction, and effects (via simulation, if any)?

□Answer□ Since currently there is no SL QoS report, MDT extension including this part will enable the prediction of SL QoS. Regarding the Uu interface, more timely and accurate MDT information (e.g. seconds granularity MDT information) can be used for prediction input. The accuracy of the prediction will be improved largely.

7 – Nokia Denmark

will it include enhanced SL QoS monitoring capabilities?

Answer: Yes, enhanced SL QoS monitoring capabilities are required to support SL QoS prediction.

8 – Samsung Electronics Co.

Q1: Is it the correct understanding that the proposal of supporting sidelink operations over unlicensed spectrum up to 71 GHz targets both 5/6 GHz and 60 GHz unlicensed bands?

Answer: Yes, and given the motivation is to support multi-Gigabit/s services (e.g. XR,) via sidelink, 60 GHz unlicensed bands can be prioritized due to its much wider available bandwidth than in FR1.

Q2: For proposal 1, regarding reuse of existing Uu physical layer framework, do you envision this to be only the NR-U (unlicensed) framework, or will it also include the NR Uu-licensed framework as well?

Answer: We think both can be considered.

Q3: For proposal 1, can proposal 1 meet requirement(s) of AR/VR gamining?

Answer: With proposal 1, particularly the beam-based sidelink operation on 60 GHz band, we think the multi-Gigabit/s data rate requirement can be satisfied.

Q4: For proposal 3, in Mode 1, gNB schedules UEs on PC5. If a UE is scheduling another UE, does this assume the scheduling UE automously determines SL resources, for the scheduled UE, or the resources are allocated by the gNB and relayed by the scheduling UE to the scheduled UE?

Answer: We think a set of resources can be provided by the network to a UE (e.g. platooning header, RSU, etc), and the UE can further decide on how to allocate those resources to one or multiple UEs via sidelink. It is also possible that gNB can instruct the UE to relay the sidelink grant to other UE(s).

Q5: For SL Positionig, what is your view on SL positioning WI: Part of Rel-18 SL WI, part of Rel-18 Positioning WI, or a seperate WI?

Answer: We think it can be decided later when the scopes of sidelink positioning, sidelink enhancements, and positioning enhancements are clearer.

Q6: For QoS prediction enhancement (Proposals 7 and 8), these proposlas are understood to enhance QoS related measurement for V2X like usage and sidelink. Are the proposals to be part of SON/MDT WI?

Answer: We just want to highlight the use case here, it should be in MDT WI (Maybe also for SON).

9 – Apple (UK) Limited

Thanks for the contribution. On Proposal 7 and 8, could you please elaborate more how the QoS prediction impacts Uu or sidelink?

Answer: The prediction of QoS on Uu and SL can be provided to a UE (vehicle) as pre-notification of QoS change, so that the UE application can be adapted accordingly, e.g. change the driving mode. The prediction result can also be provided to the network so that the network can adapt the configuration and optimize the performance.

10 – MediaTek Inc.

Thanks for the contribution. We would like to understand in relation to the FR1-assisted unlicensed sidelink on FR2, is the assisting FR1 spectrum assumed to be licensed, or do you contemplate FR1 SL-U assisting FR2 SL-U?

Answer Both can be considered.

2.6 RWS-210446 NR multicast broadcast enhancements

Feedback Form 11: Comments and questions to RWS-210446

1 – Classon Consulting

[for FUTUREWEI]

SFN is interesting. What is your intent for numerology/CP?

2 – Xiaomi Communications

Question 1: As delivery mode 2 of Rel-17 is able to support broadcast service, what would be the extra enhancements for FTA?

Question 2: Should we also consider MR-DC support for Rel-18 MBS?

3 – China Telecommunications

We are intersted in multicast for RAN sharing deployment. It will improve the radio resource efficience. However, UE group in CN1 may not request the multicast service at the same time of UE group in CN2. What is the method for this issue?

4 – Sony Europe B.V.

Due to complexity involving feedback, is it necessary to support multicast reception in idle mode?

5 – Lenovo Information Technology

Q1: do you think SYNC protocol should be used for SFN across gNBs and DUs??

Q2: what's the standard impact on RAN sharing case? We suppose RAN sharing should be supported in Rel-17 naturally.

Q3: do you think MBS in MR-DC, e.g. supporting MBS in SCG, should be supported?

Q4: we support **Multicast reception in RRC_INACTIVE/IDLE state**

6 – Qualcomm Incorporated

Rel-17 already supports intra-DU SFN. In our view, wide Area SFN increases complexity without necessarily improving efficiency in dense deployments.

In our understanding FTA is just a service requirement defined in TS 22.101, and has nothing to do with RAN. The solution defined by SA2, which also impacts RAN, is Receive Only Mode (ROM). So, we wonder whether you actually meant ROM?

We wonder how multicast can be supported in idle? According to R17 SA2 system design, "multicast" is supported in NAS CM_CONNECTED however the UE in RRC_IDLE is in NAS CM_IDLE. Additionally,

”broadcast” is already supported in all RRC states. We think multicast reception in RRC_INACTIVE state can save UE power, but RRC_IDLE should be excluded.

7 – LG Electronics Polska

In Proposal 3, it seems like the handling of different TMGIs from different operators, which may be the same service? Service alignment is necessary in RAN, is it correct understanding?

8 – MediaTek Inc.

Can you clarify if there is any RAN2 standards impact for the following two issues (1)MBS broadcast optimization for FTA deployment (2) MBS resources optimization in RAN sharing deployment

9 – CATT

Thank you for the contribution. CATT supports MBS enh. in R18.

One question for clarification:

Could you explain a bit more on the main benefit and impact/complexity for SFN in R18?

10 – Intel Corporation (UK) Ltd

For SFN support, is the intention is to support inter-CU SFN?

11 – ZTE Corporation

Thanks for the contribution, we have the following questions:

- Do you see the need to support simultaneous reception of MBSFN and unicast even if they can be with different numerologies?
- Can the sync between gNBs up to network implementation?
- If multicast in RRC_INACTIVE is supported, how to guarantee the reliability/QoS of multicast in RRC_INACTIVE ?
- for large area SFN transmission, can the requirement already be met by Rel-16 LTE based 5G Terrestrial Broadcast?
- Is FTA an SA/CT issue?
- Is RAN sharing a RAN issue or can it be figured out in service layer?

2.6.1 Answers

Feedback Form 12: Answers from Huawei to questions and comments on RWS-210446

1 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you all for the interesting questions ! To help the reader we copied again the questions below and add our answers one by one:

Classon Consulting

1

[for FUTUREWEI]

SFN is interesting. What is your intent for numerology/CP?

□Huawei□ We do see the benefit of SFN even with Rel-15 numerology/CP for example 15K SCS/normal CP, and extending CP to 16.7us for 15K SCS would harvest significantly more benefits in our view, but of course it would have some impact on UE hardware, and we are interested to hear more considerations about this aspect from companies

Xiaomi Communications

2

Question 1: As delivery mode 2 of Rel-17 is able to support broadcast service, what would be the extra enhancements for FTA?

□Huawei□ We share the same understanding that Rel-17 DM2/broadcast can be used to deploy FTA. On the other hand, in order to share the capabilities for unicast and FTA, as specified in LTE, the UE should report the capability reduction for unicast due to FTA carrier reception and so on and this may not be able to be supported in Rel-17.

Question 2: Should we also consider MR-DC support for Rel-18 MBS?

□Huawei□ We think we can discuss this issue for separate scenarios: For NE-DC, we think Rel-17 MBS can be applied without extra efforts. For EN-DC we do not see the need for NR MBS as it would require supporting NR MBS in S1. For NR-DC, we are open for discussion. If there is a commercial requirement for this scenario we think this can be specified in Rel-18, we are interested to hear more considerations about this from other companies.

China Telecommunications

3

We are interested in multicast for RAN sharing deployment. It will improve the radio resource efficiency. However, UE group in CN1 may not request the multicast service at the same time of UE group in CN2. What is the method for this issue?

□Huawei□ We are considering mainly scenarios where users from different operators are interested in the same MBS service at the same time, which should be the most common scenario. For example, OTT application server delivers regional live events/gaming to users subscribed to different operators in the same region. Another example is V2X server collects uplink messages from UEs in the same region and delivers the collected messages to all UEs subscribed to different operators in this region.

To answer your question directly, since the RAN resources are shared, it is not important which subscribers request the service and the requests can happen with the CN of the subscribed operator.

Sony Europe B.V.

4

Due to complexity involving feedback, is it necessary to support multicast reception in idle mode?

□Huawei□ We agree that supporting multicast reception in idle mode is somehow more complex than in INACTIVE mode, but since this enhancement is for congestion scenario, we suppose it is better to not support feedback for both RRC-INACTIVE/IDLE for multicast reception.

Lenovo Information Technology

5

Q1: do you think SYNC protocol should be used for SFN across gNBs and DUs??

□Huawei□ We think there should be some content synchronization mechanism across gNBs/DUs for SFN. But we are open to discuss how to achieve this, for example by RAN based sync, LTE-like sync protocol, or even implementation based approaches.

Q2: what's the standard impact on RAN sharing case? We suppose RAN sharing should be supported in Rel-17 naturally.

□Huawei□ Yes, Rel-17 MBS can work in RAN sharing scenario, but we do see a possibility to optimize the radio resources in MOCN. For example, if one OTT server requests the same service delivery from multiple operators sharing a RAN network, several independent TMGIs will be allocated and RAN will treat these TMGIs as different services and thus allocate separate radio resources for each of them. As a consequence, the same contents/data will be transmitted twice. We think this duplicated transmission can be avoided if RAN was aware of such situation. If some simple approaches were specified for RAN to recognize the same service from different CNs, that would be useful to reduce the radio resources consumption in MOCN.

Q3: do you think MBS in MR-DC, e.g. supporting MBS in SCG, should be supported?

□Huawei□: Please see the answer to Xiaomi Q2

Q4: we support **Multicast reception in RRC_INACTIVE/IDLE state**

□Huawei□: Good to know that, thank you.

Qualcomm Incorporated

6

Rel-17 already supports intra-DU SFN. In our view, wide Area SFN increases complexity without necessarily improving efficiency in dense deployments.

□Huawei□: SFN gain would increase with the increase of SFN area size, also in dense deployments. Hence, we are not sure why it is claimed that "wide Area SFN increases complexity without necessarily improving efficiency in dense deployments"□

In our understanding FTA is just a service requirement defined in TS 22.101, and has nothing to do with RAN. The solution defined by SA2, which also impacts RAN, is Receive Only Mode (ROM). So, we wonder whether you actually meant ROM?

□Huawei□:Yes, what we mean is that we need to provide a solution on RAN side for FTA. 'ROM' is the LTE solution name for FTA, probably we can consider some new terminology in NR to distinguish with LTE ROM, but the naming is something that can be discussed later on.

We wonder how multicast can be supported in idle? According to R17 SA2 system design, "multicast" is supported in NAS CM*CONNECTED however the UE in RRC*IDLE is in NAS CM*IDLE. Additionally, "broadcast" is already supported in all RRC states. We think multicast reception in RRC*INACTIVE state can save UE power, but RRC_IDLE should be excluded.

□Huawei□: In Rel-17 the "multicast" is indeed supported only in NAS CM_CONNECTED, hence the support of multicast in IDLE would require also some work in SA2 in Rel-18. We are open to discuss whether to also support RRC-IDLE in addition to RRC-INACTIVE.

LG Electronics Polska

7

In Proposal 3, it seems like the handling of different TMGIs from different operators, which may be the same service? Service alignment is necessary in RAN, is it correct understanding?

□Huawei□: Yes, please also refer to the answer to CTC and Lenovo Q2.

MediaTek Inc.

8

Can you clarify if there is any RAN2 standards impact for the following two issues (1) MBS broadcast optimization for FTA deployment (2) MBS resources optimization in RAN sharing deployment?

□Huawei□: For FTA, please see the answer to Xiaomi Q1. For RAN sharing, please see the answer to CTC and Lenovo Q2.

CATT

9

Thank you for the contribution. CATT supports MBS enh. in R18.

One question for clarification:

Could you explain a bit more on the main benefit and impact/complexity for SFN in R18?

□Huawei□: As the SFN can translate interference signal to useful signal, it could increase the SINR and thus can improve spectrum efficiency. It is also useful to improve the reliability for UEs at the cell edge by combining the signal from neighbor cells. The main complexity stems from the requirement to ensure network synchronization. In addition, if extended CP was to be defined, there would some additional complexity to support this (but with significant gains in terms of performance and efficiency).

Intel Corporation (UK) Ltd

10

For SFN support, is the intention is to support inter-CU SFN?

□Huawei□: We think inter-gNB SFN for aggregated architecture should be supported and the same/similar solutions can be applied to both inter-DU and inter-CU case.

ZTE Corporation

11

Thanks for the contribution, we have the following questions:

- Do you see the need to support simultaneous reception of MBSFN and unicast even if they can be with different numerologies?

□Huawei□: We think they can be supported at least in TDM manner.

- Can the sync between gNBs up to network implementation?

□Huawei□: This is one possibility that can be considered. Please see the answer to Lenovo Q1 for more detailed answer.

-

If multicast in RRC*INACTIVE is supported, how to guarantee the reliability/QoS of multicast in RRC*INACTIVE?

□Huawei□: Since this enhancement is for network congestion scenario, we think it would be acceptable that reliability/QoS is worse compared to multicast delivered for UEs in RRC CONNECTED state.

-

For large area SFN transmission, can the requirement already be met by Rel-16 LTE based 5G Terrestrial Broadcast?

□Huawei□: Actually we don't intend to introduce new smaller SCS as LTE EnTV for large area SFN, because it would bring huge impact on UE/Network hardware design and so could be hard to be commercialized, we could consider use existing SCS/CP and probably ECP for existing SCS for NR SFN to better utilize the NR ecosystem.

-

Is FTA an SA/CT issue?

□Huawei□: We think both SA/CT and RAN should be involved in this topic. Please see reply to Xiaomi Q1 for details of RAN impacts.

-

Is RAN sharing a RAN issue or can it be figured out in service layer?

□Huawei□: We think RAN needs to be aware that the same service is provided by multiple operators. Details can be found in answer to CTC and Lenovo Q2.

2.7 RWS-210453 Passive IoT for 5G-Advanced

Feedback Form 13: Comments and questions to RWS-210453

1 – Classon Consulting

[for FUTUREWEI]

Harvesting energy is interesting

---

2 – vivo Communication Technology

[vivo]

We are interested in this new area to further expand the 5G NR to the new market. And we have following questions and comments to better understand the technical aspects,

(1) For envelope detection for downlink, the detection is limited by the receiver sensitivity and energy consumption. which receiver sensitivity and coverage range are you expecting for 1uW power consumption and its corresponding receiver architecture? Furthermore, we think this part has some commonality with the ultra-low power wake-up radio proposal as proposed by companies.

(2) For Backscatter communication for uplink, from our assessment more work is needed to be done

compared with the downlink part, including the following

- OOK waveform design,
- New coding schemes,
- Initial access procedure
- User multiplexing and collision handling, such as new MAC layer design

Which in general would requires redesign of current Uu interface for L1/L2/L3, we wonder what is Huawei's assessment of the amount of work required, and what would be the goal and plan for Rel-18. A step-by-step approach makes more sense from our perspective.

3 – Beijing Xiaomi Mobile Software

We see a couple of proposals in this space and they are genuinely interesting and provide opportunities for 3GPP.

It seems that the targeted market for these types of devices is below existing 3GPP RAT capabilities is this correct?

Is it intended that the data transmissions are triggered by simple activations and commands, requiring minimal processing? Or are high data rate or frequent transmissions expected?

Is it envisaged that the connectivity range shall extend far enough to connect to a fixed node e.g. gNB like, or that the connection to a network is (relayed) via an associated device/reader or handset? I note the description mentions "long distance".

You mention positioning as an advantageous design attribute, if the RF range was limited this could aid positioning (and device integrity) by proximity association with the network connecting device, or do you envisage some other mechanism or specific positioning related measurements/feature within this low power device?

4 – Sony Europe B.V.

Slide 2: For the power consumption of 1-100uW, what traffic model do you assume? Is this the power when the device is "on", or the average power consumption over some longer time period?

Slide 5: what are the coverage / SINR performance impacts of operating with a non-coherent receiver / waveform?

Slide 6: what is the coverage available from backscattering? What waveform is applied with backscattering? Which spectrum is used for the backscattered signal?

Slide 7: comment. We think that the list of issues that need to be studied is good.

General comment. You seem to be proposing a study. What are the timeframes for standardisation? For example, a Release-18 study and normative work in Rel-19?

In RWS-210302 and RAN-R18-WS-non-eMBB-SONY, we also discuss zero power communications.

5 – CATT

Thanks for the interesting proposal of passive IoT. We believe that this is the one direction for IoT evolution with low power consumption and low cost. A few questions are as follows,

(1) What is the design target and requirements for passive IoT device?

(2) If you use envelope detector and OOK, what is the purpose of the study of modulation and coding?

(3) What is the target coverage distance with the passive device when the passive receiver sensitivity is very low?

(4) What is the frequency band considered for the passive IoT device operation?

6 – Lenovo (Beijing) Ltd

Thanks for the contribution. We support the scenarios and market need proposed in 0453.

1) Do you want to study/design a new RAT in NR similar as NBIoT in LTE?
2) Smaller BW is necessary, do you have rough value in mind? e.g., smaller than 180KHz?
3) Do you have the study trend for simplifying higher layer protocol to support personal IoT?

7 – Samsung Electronics Co.

Do you assume the passive IoT devices still coexist with legacy UEs and reuse legacy intial access procedure? If so, coherent based detection is still needed at least for intial accesss. Can you clarify the performance targets such as data rate, latency, relaibility for the ultra-low power consumption devices based on envelope detection based modulation and decoding?

8 – Intel Corporation (UK) Ltd

Q1: Could you kindly provide examples of target data rates/QoS/performance that would be helpful in ensuring sufficient differentiation from NB-IoT?

Q2: Given that such extreme low-cost/low-power device support would necessitate a new RAT design, could you share inptus on urgency/market demands and business viability/needs for a new cellular IoT solution?

9 – DOCOMO Communications Lab.

Thanks for the good contribution. We would like to ask following questions:
Q1. Do you assume backscatter communication is used for gNB-UE communication?
Q2. Do you have any coverage assumption on backscatter communication?

2.7.1 Answers

Feedback Form 14: Answers from Huawei to questions and comments on RWS-210453

1 – Huawei Tech.(UK) Co.. Ltd

1- Classon Consulting

[for FUTUREWEI]

Harvesting energy is interesting.

[Answer]

Thanks!

2- vivo Communication Technology

Question 1:

For envelope detection for downlink, the detection is limited by the receiver sensitivity and energy consumption. Which receiver sensitivity and coverage range are you expecting for 1uW power consumption and its corresponding receiver architecture? Furthermore, we think this part has some commonality with the ultra-low power wake-up radio proposal as proposed by companies.

[Answer]

Yes, envelope detection for downlink receiving is suitable for both wake-up radio and Passive IoT, as it can reduce power consumption of receiving processing to microwatts level.

Envelope detection impacts the link budget of information transmission in downlink, while energy harvesting impacts the link budget of wireless power transmission. For passive devices relying on energy harvested from received signals, the bottleneck will be the minimum power required to activate the rectifier circuit for RF power harvesting. Currently, the threshold is around -30 dBm for optimal design. If passive IoT devices harvest energy from other sources (e.g., solar and illumination), the link budget should take backscatter communication into account. In backscatter communication, the uplink signals are generated by reflecting the received downlink signals. The power of reflected signals decrease with the decreased power of received downlink signals. It means that the RSRP threshold of received downlink signals shall not be too low. Otherwise, the link budget of uplink will be much worse than downlink. The optimal balanced link budget between downlink and uplink needs to be studied for the case.

Question 2:

For Backscatter communication for uplink, from our assessment more work is needed to be done compared with the downlink part, including the following

-OOK waveform design,

-New coding schemes,

-Initial access procedure

-User multiplexing and collision handling, such as new MAC layer design

Which in general would requires redesign of current Uu interface for L1/L2/L3, we wonder what is Huawei's assessment of the amount of work required, and what would be the goal and plan for Rel-18. A step-by-step approach makes more sense from our perspective.

[Answer]

We generally agree with you about the issues to be studied about backscatter communication for uplink.

The target of passive IoT is to open new huge IoT markets with tens or hundreds of times more connections than LPWAN. The key point is to enable batteryless devices with energy harvesting.

According to our analysis, the power provided by energy harvesting is usually less than 1 mW considering limitations on the size of devices. It is hard for existing cellular devices to achieve such low power consumption. For example, the power consumption of receiving processing is usually several tens of milliwatts for NB-IoT device. The power consumption of transmitting with 0 dBm transmit power is also several tens of milliwatts for NB-IoT device. As a result, new technology has to be studied to achieve the goal. It is better to begin the study at an early opportunity, and plan how to execute eventual standardization once that is completed, so that time-sensitive opportunities can be exploited.

3 - Beijing Xiaomi Mobile Software

Question 1:

It seems that the targeted market for these types of devices is below existing 3GPP RAT capabilities is this correct?

[Answer]

Yes, passive IoT aims for ultra-low cost and power devices for targeted markets. The target of power consumption optimization is to enable energy harvesting for the devices, as many applications prefer or require batteryless devices. According to our analysis, the power provided by energy harvesting is usually less than 1mW considering limitations on the size of devices. It is hard for existing cellular devices to achieve such low power consumption. For example, the power consumption of receiving processing is usually several tens of milliwatts for an NB-IoT device. The power consumption of transmitting with 0 dBm transmit power is also several tens of milliwatts for NB-IoT devices. As a result, new technology has to be studied to achieve the goal.

Question 2:

Is it intended that the data transmissions are triggered by simple activations and commands, requiring minimal processing? Or are high data rate or frequent transmissions expected?

[Answer]

The targeted applications of passive IoT share the traffic model with low data rate and small packets. Meanwhile, the ultra-low cost and power device would necessarily be not designed to support wideband communication for high data rate. So it is intended for data transmissions are triggered by simple activations and commands.

Question 3:

Is it envisaged that the connectivity range shall extend far enough to connect to a fixed node e.g. gNB like, or that the connection to a network is (relayed) via an associated device/reader or handset? I note the description mentions "long distance".

[Answer]

The use cases are mostly in indoor scenarios. The target is to match the coverage of indoor deployments of cellular network. For example, the distance between pico RRUs in indoor small cell system is around 30 meters, which is a "long distance" by comparison to the scanning distance of several or a few tens of centimeters for barcodes.

Question 4:

You mention positioning as an advantageous design attribute, if the RF range was limited this could aid positioning (and device integrity) by proximity association with the network connecting device, or do you

envisage some other mechanism or specific positioning related measurements/feature within this low power device?

[Answer]

Limited RF range may be helpful for cell-ID positioning. But it is impractical to deploy Passive IoT readers with an interval of merely several meters in factories or warehouses. The use cases for passive IoT are mostly in indoor scenarios and typically where very high device density is relevant (e.g. the logistics warehouse example we gave). The target is to match the coverage of indoor deployments of cellular network. For example, the distance between pico RRUs in indoor small cell system is around 30 meters, especially in factories. Positioning techniques can be studied for passive IoT with the assumptions of practical deployment.

4- Sony Europe B.V.

Question 1:

Slide 2: For the power consumption of 1-100uW, what traffic model do you assume? Is this the power when the device is "on", or the average power consumption over some longer time period?

[Answer]

The targeted applications of passive IoT share the traffic model with low data rate and small packets.

The power consumption of 1 100 uW is for device receiving or transmitting.

Question 2:

Slide 5: what are the coverage / SINR performance impacts of operating with a non-coherent receiver / waveform?

[Answer]

Envelope detection affects the link budget of information transmission in downlink, while energy harvesting affects the link budget of wireless power transmission. For passive devices relying on energy harvested from received signals, the bottleneck will be the minimum power required to activate the rectifier circuit for RF power harvesting. Currently, the threshold is around -30 dBm for optimal design. If passive IoT devices harvest energy from other sources (e.g., solar and illumination), the link budget should take backscatter communication into account. In backscatter communication, the uplink signals are generated by reflecting the received downlink signals. The power of reflected signals decrease with the decreased power of received downlink signals. It means that the RSRP threshold of received downlink signals shall not be too low. Otherwise, the link budget of uplink will be much worse than downlink. The optimal balanced link budget between downlink and uplink needs to be studied for the case.

Question 3:

Slide 6: what is the coverage available from backscattering? What waveform is applied with backscattering? Which spectrum is used for the backscattered signal?

[Answer]

The use cases are mostly in indoor scenarios. The target is to match the coverage of indoor deployments of cellular network. For example, the distance between pico RRUs in indoor small cell system is around 30 meters, especially in factories (e.g. InF NLOS).

The optimal waveform for backscatter communication needs to be studied considering the ultra-low cost and power transmitter. The transmitter would not be able to apply complicated waveforms for the reflected signal.

Regarding the spectrum, sub-GHz bands looks more suitable for passive IoT. The propagation loss is relatively smaller in sub-GHz bands, which is beneficial to the coverage considering the limited link budget.

Question 4:

Slide 7: comment. We think that the list of issues that need to be studied is good.

[Answer]

Thanks!

Question 4:

General comment. You seem to be proposing a study. What are the timeframes for standardisation? For example, a Release-18 study and normative work in Rel-19?

[Answer]

Yes, a Rel-18 study and normative work in Rel-19 would be fine to meet the commercial deployments of 5G advanced networks.

Question 5:

In RWS-210302 and RAN-R18-WS-non-eMBB-SONY, we also discuss zero power communications.

[Answer]

Yes, we noticed the proposal of supporting devices powered by energy harvesting in your paper. We also think it is one important direction for IoT evolution. We think it is good to start study efforts on newer areas at an early opportunity to be ready for the market

5- CATT

Question 1:

What is the design target and requirements for passive IoT device?

[Answer]

To enable passive IoT device working with energy harvesting, the power consumption of signal and protocol processing should be as low as possible. Considering the limited size of IoT devices, the harvested energy is usually below 1 mW. Take indoor illumination as energy source for example, the harvested energy is about 10 uW/cm^2. As a result, it is suggested that passive IoT devices target power consumption of 1 100 uW.

In logistics and warehousing, the cost of passive IoT devices for goods management and tracking is expected to not be significantly higher than the cost of a barcode. For example, a passive IoT tag pasted on each parcel ought to be at $0.01 level. For asset management and tracking in manufacturing and logistics industries, tags with a little higher cost may be acceptable. For industrial wireless sensor networks, the passive IoT module in each sensor needs to be not be more expensive than the sensor itself. The average price of sensors is forecast to approach $0.5 by 2025. In general, the acceptable cost of passive IoT device may be $0.01 0.1.

Question 2:

If you use envelope detector and OOK, what is the purpose of the study of modulation and coding?

[Answer]

Literature suggests that OOK/ASK are among the good candidates, however the overall channel coding and link budget need to be taken into consideration, as well as the possibility of other modulation schemes (such as e.g. BPSK) before a direction is taken in 3GPP.

Question 3:

What is the target coverage distance with the passive device when the passive receiver sensitivity is very low?

[Answer]

The use cases of passive IoT are mostly in indoor scenarios. The target is to match the coverage of indoor cellular network deployments. For example, the distance between pico RRUs in indoor small cell systems is around 30 meters.

Question 4:

What is the frequency band considered for the passive IoT device operation?

[Answer]

Sub-GHz bands look more suitable for passive IoT. The propagation loss is relatively smaller in sub-GHz bands, which is beneficial to the coverage considering the limited link budget of passive IoT.

6- Lenovo (Beijing) Ltd

Question 1:

Do you want to study/design a new RAT in NR similar as NB-IoT in LTE?

[Answer]

To reduce UE power consumption to microwatts level, the fundamental signal processing is different from existing cellular systems for passive IoT.

Question 2:

Smaller BW is necessary, do you have rough value in mind? e.g., smaller than 180KHz?

[Answer]

Yes, we agree that smaller BW is necessary. There are four main reasons to choose narrow transmissions for passive IoT:

1) The targeted applications of passive IoT share traffic model with low data rate and small packets.

2) Wideband transmission means high sampling rate for signal processing, which leads to the increase of complexity and power consumption for passive IoT devices. The ultra-low cost and power device is hard to support wideband transmissions for high data rate.

3) Wideband transmission cannot help wireless power transmission.

4) Since OOK/ASK is low order modulation, wideband transmission with such inefficient modulation is uneconomical for licensed spectrum.

Question 3:

Do you have the study trend for simplifying higher layer protocol to support personal IoT?

[Answer]

Protocol processing usually involves MCU and memories, both of which take large proportions in the area and power consumption of UE chipset, especially considering the very simple physical layer processing for passive IoT. The higher layer protocol should be carefully designed with minimized functionalities and features

7- Samsung Electronics Co.

Question 1:

Do you assume the passive IoT devices still coexist with legacy UEs and reuse legacy initial access procedure? If so, coherent based detection is still needed at least for initial access. Can you clarify the performance targets such as data rate, latency, reliability for the ultra-low power consumption devices based on envelope detection based modulation and decoding?

[Answer]

The complexity of the protocol stack has a big impact on the cost and power consumption of devices. In our opinion, it is hard to reuse initial access scheme of NR or LTE for passive IoT devices.

The tradeoff for ultra-low cost and power consumption of devices is coverage. Envelope detection for downlink and backscatter communication for uplink both impact the link budget. The use cases of passive IoT are mostly in indoor scenarios. The target is to match the coverage of indoor deployments of cellular network. For example, the distance between pico RRUs in indoor small cell system is around 30 meters.

The targeted applications of passive IoT share the traffic model with low data rate and small packets. Therefore, the ultra-low cost and power device does not need to support wideband communication for high data rate. So the peak data rate of passive IoT may be a few tens of kbps, while several hundreds of bps for the worst coverage. The requirements of latency and reliability may also need to be relaxed. For example, a latency of hundreds of milliseconds or even several seconds may be acceptable.

8- Intel Corporation (UK) Ltd

Question 1:

Could you kindly provide examples of target data rates/QoS/performance that would be helpful in ensuring sufficient differentiation from NB-IoT?

[Answer]

Compared with NB-IoT, the most obvious difference is for device power consumption. The power consumption of receive processing is usually several tens of milliwatts for NB-IoT devices. The power consumption of transmitting with even 0 dBm is also several tens of milliwatts for NB-IoT devices. Energy harvesting does not reach into those ranges. Passive IoT aims for device power consumption of microwatts level, which is hundreds or thousands of times lower than NB-IoT. The cost of passive IoT devices is also ten or hundred times lower than NB-IoT due to their very simple implementation.

The targeted applications of Passive IoT share the traffic model with low data rate and small packets. Meanwhile, the ultra-low cost and power device does not need to support wideband communication for high data rate. So the peak data rate of passive IoT may be a few tens of kbps, while several hundreds of bps for the worst coverage. The QoS requirements may also need to be relaxed, and to what extent would be something for studying.

Question 2:

Given that such extreme low-cost/low-power device support would necessitate a new RAT design, could you share inputs on urgency/market demands and business viability/needs for a new cellular IoT solution?

[Answer]

Take the manufacturing industry for example, one use case is materials and assets management. Currently it is done based on barcodes printed on papers. There may be more than ten separated areas in a big factory. When the materials are moved from one to another, old barcode has to be scanned closely by handheld scanner in origin area, while new barcode has to be printed and pasted on the corresponding boxes or pallets in target area. For inventory, thousands of barcodes distributed in a large area need to be scanned one by one, which requires the containers being carefully placed to make sure barcodes on them not be blocked. In general, the current situation is very labor intensive and time consuming. Passive IoT is expected to significantly improve the transportation efficiency of materials for higher production efficiency.

Another use case is industrial sensor network. As also mentioned in everactive's paper (RWS-210085), more and more sensors are to be used for production automation. Wireless sensor network has the advantage of easy deployment, but suffers from the maintenance cost for battery replacement. In other words, battery replacement limits large-scale adoption of wireless sensors. Passive IoT aims for ultra-low power devices which can be powered by energy harvesting other than battery.

Manufacturing and logistics industries show great interest in the two use cases, especially the first one. Some non-cellular technologies (RFID/WiFi/UWB/etc.) have been researched to provide solutions for the two use cases. Though those solutions still have to fix some problems, competitive solutions may emerge from them in the near future. It may be too late to wait until after 2025 when 5G advanced cellular technologies to enter the markets. With the anticipated deployment of 5G for industry automation, passive IoT can be deployed co-located with indoor 5G infrastructure to provide additional services, which makes cellular solutions more efficient and attractive.

9- DOCOMO Communications Lab.

Question 1:

Do you assume backscatter communication is used for gNB-UE communication?

[Answer]

Yes, we assume that backscatter communication is used for uplink transmissions.

Question 2:

Do you have any coverage assumption on backscatter communication?

[Answer]

The use cases of passive IoT are mostly in indoor scenarios. The target is to match the coverage of indoor deployments of cellular network. For example, the distance between pico RRUs in indoor small cell system is around 30 meters.

2.8 RWS-210454 UE reliability

Feedback Form 15: Comments and questions to RWS-210454

1 – LG Electronics Inc.

We share the identified issue of legacy backup mechanism and see the need for enhancement. LG also highlighted in RWS-210229 the cost of legacy backup mechanism and proposed some enhancement for resource-efficiency. To understand more on the potential enhancement area, we would like to ask

Q1. Do you assume the UE association is done by the network or the UE by itself based on some interaction between the UEs?

Q2. When detecting a failure of a UE, do you assume the backup UEs try to deliver the failed data, i.e., the

same information as the failed UE tried to transmit, or the backup UEs just start from what it can transmit?

Q3. For synchronized sequence number, do you have specific layer 2 in mind for that?

2 – Sony Europe B.V.

1) What is the latency is expected in switching over to backup UE?

2) Which layer is the messaging expected to be, in failure detection and indication of switching to backup UE?

3 – Beijing Xiaomi Mobile Software

Thanks for the contribution.

We are interested in this use case of negotiation/coordination procedures between multiple UE devices for back up reasons.

Some questions to ask:

1) Do you mean when the 2 UEs work well, traffic data is duplicated to two UEs at the same time, i.e., traditional UE backup is used?

Is this necessary? As you also confirmed that double resource is used?

2) We agree that the RAN could indicate another UE to take over the task of the failed UE.

Regarding to ”Low latency and seamless taking over mechanism”:

If the same packet sequence number can be guaranteed between two UEs, RAN node can indicate backup UE to transmit the rest unsent packets of the breakdown UE in sequence to ensure no data loss.”

Does that mean the unsent packets of the breakdown UE should be transferred to the backup UE? What is the interface between those UEs? Are we going to specify the interface between those UEs?

4 – Spreadtrum Communications

Thanks for the nice contribution. We ave some questions:

1. Is the backup UE association relationship only stored in RAN?

2. When the failure is detected, the taking over indication to the target UE is transmitted by gNB or by UE via direct interface ?

3. What do you think about the same packet sequence number can be guaranteed between two UEs? Can you explain how to achieve this?

5 – ROBERT BOSCH GmbH

We support the SI for potential E2E reliability enhancements for URLLC traffic.

communication service availability (CSA) is one of the mechanisms that can be used to evaluate/monitor the ”open” channel concept in Functional Safety. Based on the evaluation, and CSA aware RAN, a resilience mechanism is needed.

In Proposal 1:

-

Study Backup UE association mechanism and Study low latency and seamless taking over mechanism are part of the resilience mechanisms proposed in our RAN-assisted FuSa communication RWS-210218 (objective 1-c).

- Study fast failure detection mechanism is a kind of monitoring mechanism. Therefore, RAN has to be CSA aware, Survival-time aware, burst spread aware or, in general, FuSa aware. This monitoring is inline with objective 1-a) in our TDoc RWS-210218.

Questions:

- Does Huawei support a RAN-assisted FuSa, at least, in the sense of monitoring failure and performing resilience mechanisms ?
- Does Huawei supports pQoS for proactive/predictive monitoring and proactive backup ?
- Does Huawei sees the need to identify safety related traffic to lower layers or you believe that all URLLC traffic should be handled similarly ?
  - If the later, how to identify URLLC traffic (for monitoring) at the receiver for a mixed traffic UE? is existing QoS flow enough or we need more identifiers (e.g., SA2 discussion)?

6 – Intel Corporation (UK) Ltd

Q1: Do you expect the reliability of the transmission can be reduced if the traditional UE duplication is replaced by the backup UE concept since the diversity leg is now omitted?

Q2: For the very fast ramp-up of the backup UE it seems it needs to be always enabled and thus consume similar energy as the active UE. Do you think there is sufficient power saving gain in this case?

2.8.1 Answers

Feedback Form 16: Answers from Huawei to questions and comments on RWS-210454

1 – HuaWei Technologies Co.

LG Electronics Inc. #1

HW's reply:

Q1. We understand the most important thing here in general is to let the network be aware of UE's association. How to provide this association could be done by the network, or if UEs has PC5 interface as L2 SL relay, some assistance information can also be provided by the UE.

Q2. From the perspective of reliability, the backup UE is better to deliver the failed data based on the feedback from network.

Q3. We think PDCP layer can support synchronization of sequence numbers. Similarly as MBS, gNBs can synchronize PDCP sequence numbers according to GTP-U number to ensure seamless handover.

Sony Europe B.V. #2

HW's reply:

Q1: at least survival time level latency should be guaranteed. We are open to discuss other latency requirements if needed.

Q2: we are open to which layer do failure detection, it could be L1/L2 level detection which can be fast. Correspondingly indication of switching could be L1/L2 signaling for faster switch, or RRC signaling for more latency tolerant cases, it depends on the latency requirement in the end.

Beijing Xiaomi Mobile Software # 3

HW's reply:

Q1: Take uplink as an example. We understand the industry node could send data to both UEs, but the two UEs will not send the data over Uu interface at the same time, and only one of them sends the data normally. Once one UE is broken, the other UE can send the data to the network immediately. By doing so the requirement for URLLC/IIoT can still be fulfilled with minimized radio resources. If the industry node only sends the data to one UE at the very beginning, the recovery from the other UE has to start from retrieving the data from the industry node, which takes longer time and is not desirable for URLLC/IIoT.

If your question is whether we need double resource over Uu interface, it was not our intention. We only require one radio resource via Uu interface at a time.

Q2: the traffic data is buffered to two UEs at the same time, and only one UE transmits data to network. If serving UE breakdown is detected, network indicates the backup UE to continue to transmit traffic data. In this procedure, it is not needed to specify the interface between UEs and there is only Uu impact.

Spreadtrum Communications# 4

HW's reply:

Q1: we think CN may need to be involved. For example, to consider only one PDU session for those backup UEs to avoid redundancy N3 resource consumption, subscription information check to indicate whether two UEs are allowed to be associated, etc.

Q2: we think gNB can send this taking over indication. If L2 SL relay is considered, backup UE can detect whether serving UE breaks down or not, and then provide this information to gNB.

Q3: we think PDCP layer can support synchronization of sequence numbers. Similarly as MBS, gNBs can synchronize PDCP numbers according to GTP-U number to ensure seamless handover.

5 – ROBERT BOSCH GmbH#5

Q1: we support to consider mechanisms to detect failure for resilience system. For detail solutions, we can discuss case by case. At least in our view this UE reliability is one potential solution to support your requirement.

Q2: It is a bit unclear for us what is the exact meaning of pQoS for proactive/predictive monitoring, and we think current SON/MDT may already support part of them and we are open to enhance these features to monitor the QoS. Regarding proactive backup, we understand our proposal is to ensure the two UEs would have the same data and once one UE is broken, the backup UE can send the data to the network immediately. If this is what you meant as proactive backup, we think we are aligned.

Q3: we are not sure about the difference between safety related traffic and URLLC traffic, we understand they both require high reliability, is it also your understanding?

6 – Intel Corporation (UK) Ltd#6

Q1: this is the balance between reliability and cost as usual. If the solution can ensure immediate recovery, we think the reliability will not be significantly impacted.

Q2: in general, the serving UE transmits the traffic data to network and the backup UE doesn't transmit at the same time, so only one UE is transmitting. Although backup UE needs to consume power on PDCCH monitoring, the power consumption could be much lower especially compared with the traditional UE backup mechanism as you mentioned.

3 [Second round] Q&A

3.1 RWS-210439 5G-Advanced XR

Feedback Form 17: Further questions on RWS-210439

1 – China Unicom

Thanks for your detailed answers. And we agree with you that we can have further discussion on the metrics for specific service type in RAN QoE work. Could you please explain the further specification impacts of XQI on RAN2/3 procedures in your opinion?

2 – MediaTek Inc.

Thanks for the detailed reply.

For XQI, what kind of information should be considered beyond per packet level (Ex. for frame level)?

3.1.1 Answers

Feedback Form 18: Answers from Huawei to questions and comments on RWS-210439

1 – HuaWei Technologies Co.

1 – China Unicom

Thanks for your detailed answers. And we agree with you that we can have further discussion on the metrics for specific service type in RAN QoE work. Could you please explain the further specification impacts of XQI on RAN2/3 procedures in your opinion?

HW's Reply:

XQI is defined to be a metric to evaluate the network transmission impact on XR quality for RAN. To define such a metric, some XR-specific information, which may be useful for XR quality evaluation in RAN, can be discussed and identified in collaboration with SA4 (pending on SA4). Once SA4 defines the relevant parameters, these information can be added in NR QoE container and may make some of them visible in RAN. This part requires RAN2/RAN3 involvement based on Rel-17 QoE framework..

2 – MediaTek Inc.

Thanks for the detailed reply. For XQI, what kind of information should be considered beyond per packet

level (Ex. for frame level)?

HW's Reply:

We understand the packet importance and packet correlation could be helpful for user experience, which can determine the successful rate of frames especially for those important frames.

3.2 RWS-210442 Complementary TDD and URLLC enhancements for NR

Feedback Form 19: Further questions on RWS-210442

1 – Nokia Germany

Thanks to Huawei / HiSilicon for providing the detailed answers. Maybe some small follow-up from our side:

1. On the PDCCH enhancements, you mention smaller AL (i.e. AL<1) also. Clearly, based on the Rel-16 studies we saw some PDCCH capacity limitations – but do you think the gain of support of AL<1 considering the 'compact' DCI is not that compact (max. of 0.5-0.8dB gain) and the required reliability for URLLC will help to much (in contrast to the rather course AL granularities when going from 4 to 8)?

2. On CSI enhancements, following your clarifications, it seems that the envisioned enhancement aims at reducing interference unpredictability through constrained CSI measurements and data scheduling. While, indeed, CSI reports may better match the channel and interference conditions at the time of PDSCH transmission, multiple dependent aspects require further consideration, e.g. the impact of such restrictions on the eMBB traffic scheduling, considerations on backhaul latency, CSI configuration, etc. Given the non-negligeable impact, can you please clarify the proposed scope and use cases for such enhancement?

2 – Intel Corporation (UK) Ltd

Further Q: On the argument of co-existence with other operators, do you think the co-existence issue may still allow to configure the complementation TDD configuration, given that in every CC there may be inter-operation restrictions?

3.2.1 Answers

Feedback Form 20: Answers from Huawei to questions and comments on RWS-210442

1 – HUAWEI TECHNOLOGIES Co. Ltd.

@ Nokia

1. According to our analysis, in some cases e.g. factory scenario with coordinated mTRP transmission, the potential SINR is very high thus there is some chance to further reduce the aggregation level, even down to smaller than AL=1. Of course, if PDCCH enhancement will be included for further study, then sufficient evaluation is needed before making the decision.

2. We admit that there would be some impact on eMBB traffic scheduling for this kind of CSI enhancements, i.e. to delay the scheduling of eMBB. To reduce the impact on eMBB, one area for the CSI enhancement is to reduce the CSI processing timeline to reduce the delay of eMBB scheduling. For backhaul, there is no special requirement on it, since only the value of k needs to be exchanged among different cells. We also want to avoid too much specification impact, therefore some simple scope for this kind of

CSI enhancements includes reduced CSI processing timeline and/or potential some Xn interface enhancements. Of course, we are open to any solution if more accurate interference tracking can be achieved.

@ Intel

For co-existence with other operators, one possible way is that different TDD configurations can be used on different BWPs/subbands on the same serving cell, e.g. the upper subband and bottom subband can keep the same configuration as neighboring cell, while adjusting the configuration located in the middle subband to achieve complementary TDD.

3.3 RWS-210443 NR LPHAP and other NR positioning enhancements

Feedback Form 21: Further questions on RWS-210443

1 – ZTE Corporation

Regarding the proposal that SRS with larger bandwidth than regular data transmission for LPHAP, do you think it will cause more UE complexity which against the motivation of introducing low cost UEs?

2 – vivo Mobile Communication Co.

Thanks for your contribution.

For LPHAP, regarding decoupled communication and positioning bandwidth, you said this decoupling is not only about configuration aspects, but also UE capability aspects and the decoupling would require the hardcoded UE architecture to support different bandwidths for communication and positioning. Does this UE capability also apply to RedCap UE?

3 – China Unicom

Thanks for the clarification.

For NR LPHAP and other NR positioning enhancements, what is the any prioritized objectives? Potential scope of NR positioning enha SI/WI?

4 – Samsung Electronics Co.

Q: follow-up questions in ”Decoupled communication bandwidth and positioning bandwidth”, we assume what you proposed is that UE could have narrow bw for data while temporally enlarge the bw for positioning purpose. Do you consider to reply on angle based method rather than time based method, so that necessary bw for positioning could be same as the data one?

5 – CATT

Q1: If we understand correctly, the main motivation of proposing decoupled communication and positioning bandwidth is to use a large BW for PRS/SRS Tx/Rx, considering that positioning measurement accuracy is BW dependent. However, it also means the cost of the UE may be increased since it is required to support much larger Tx/Rx BW for positioning.

What is Huawei’s view to support LPHAP through supporting longer Tx/Rx of PRS/SRS in time-domain, and/or frequency hopping pf PRS/SRS in frequency-domain, which may avoid supporting large BW, and

also may also make the measurement more reliable by taking the advantage of frequency diversity and/or time-diversity?

6 – Spreadtrum Communications

Low power consumption is a hot topic in this R18 RAN Workshop, multiple companies propose to study e.g. passive IoT, Almost Zero Power, Energy Harvest. In this LPHAP paper, Ultra deep sleep is introduced to support the long battery life requirement, could you clarify whether there are some relationships between Ultra deep sleep and those low power consumption proposals, e.g. passive IoT which is proposed by HW as well?

3.3.1 Answers

Feedback Form 22: Answers from Huawei to questions and comments on RWS-210443

1 – Huawei Tech.(UK) Co.. Ltd

Thank you for the further questions. Here are our answers.

1 – ZTE

Regarding the proposal that SRS with larger bandwidth than regular data transmission for LPHAP, do you think it will cause more UE complexity which against the motivation of introducing low cost UEs?

Thanks for the question.

Regarding UE cost, our understanding is that supporting larger positioning bandwidth than communication would increase the RF/IF cost, and presumably would require a higher rate ADC/DAC, whereas little impact is expected for BB processing. The impact to the overall UE cost can be insignificant.

2 – vivo

Thanks for your contribution.

For LPHAP, regarding decoupled communication and positioning bandwidth, you said this decoupling is not only about configuration aspects, but also UE capability aspects and the decoupling would require the hardcoded UE architecture to support different bandwidths for communication and positioning. Does this UE capability also apply to RedCap UE?

Thanks for the question and the comment.

Regarding the feature applicability to RedCap UEs, we are open to it, but it could happen to any feature in any release during the UE feature discussion.

3 – China Unicom

Thanks for the clarification.

For NR LPHAP and other NR positioning enhancements, what is the any prioritized objectives? Potential scope of NR positioning enha SI/WI?

Thanks for the questions.

Regarding the prioritized objectives, from our side, we consider both LPHAP and carrier aggregation important to Rel-18.

Regarding the scope, we think that the overall scope of SI/WI for the further enhancements on positioning can be later discussed on the basis of workload.

4 – Samsung

Q: follow-up questions in "Decoupled communication bandwidth and positioning bandwidth", we assume what you proposed is that UE could have narrow bw for data while temporally enlarge the bw for positioning purpose. Do you consider to reply on angle based method rather than time based method, so that necessary bw for positioning could be same as the data one?

Thanks for the question.

Regarding using angle-based methods, yes angle-based methods are less sensitive to BW, yet we consider timing-based methods higher priority, since it is robust to the distance between UE and the TRP.

5 – CATT

Q1: If we understand correctly, the main motivation of proposing decoupled communication and positioning bandwidth is to use a large BW for PRS/SRS Tx/Rx, considering that positioning measurement accuracy is BW dependent. However, it also means the cost of the UE may be increased since it is required to support much larger Tx/Rx BW for positioning.

What is Huawei's view to support LPHAP through supporting longer Tx/Rx of PRS/SRS in time-domain, and/or frequency hopping pf PRS/SRS in frequency-domain, which may avoid supporting large BW, and also may also make the measurement more reliable by taking the advantage of frequency diversity and/or time-diversity?

Thanks for the questions and the comments.

Regarding the cost increase due to larger bandwidths for positioning, the increase is on RF/IF aspects and potentially a higher rate ADC/DAC. The impact to the overall UE cost can be insignificant.

Regarding other alternatives to support frequency hopping, that could be suitable for increasing accuracy, but our analysis shows that at least prolonged Rx/Tx would increase the UE power because UE needs to wake up for more symbols. The duration may be extended also if one or two symbols are reserved for RF retuning between hops.

It is not clear to us how "longer Rx/Tx of PRS/SRS in time domain" alone can increase the accuracy, but we generally think this would have the drawback to increase the UE power consumption.

6 – Spreadtrum Communications

Low power consumption is a hot topic in this R18 RAN Workshop, multiple companies propose to study e.g. passive IoT, Almost Zero Power, Energy Harvest. In this LPHAP paper, Ultra deep sleep is introduced to support the long battery life requirement, could you clarify whether there are some relationships between Ultra deep sleep and those low power consumption proposals, e.g. passive IoT which is proposed by HW as well?

Thanks for the question and the comment.

Regarding relationship with other low power devices, our view is that LPHAP should be based on a device that is powered by the battery, where non-zero power deep sleep mode is expected. For passive IoT with energy harvest, if ultra-deep sleep will be introduced needs to be studied. We think the two topics are independent.

3.4 RWS-210444 REDCAP enhancements

Feedback Form 23: Further questions on RWS-210444

1 – vivo Communication Technology

Thanks for the reply. We have additional questions as below

Q1: Regarding further reduced UE RF BW, it is expected that performance degradation will occur in both link level (less frequency diversity) and system level (less frequency selective gain, and more resource fragmentation),we wonder whether and how to compensate these performance degradation, and will the potential solutions increase the UE complexity?

Q2:For redcap positioning accuracy, we understand that frequency hopping by RF retuning may be possible. But in this case, it's hard to ensure the phase consistency among different frequency hops. However, the positioning accuracy is very sensitive to phase inconsistency, not sure what additional method can be provided to ensure phase consistency and then achieve high accuracy.

Q3: In addition to the BW reduction, we wonder what is your view on the following potential areas for Rel-18 eRedCap?1

1□ lower UE power class

2□ UE Processing time relaxation (data, CSI)

3□ Reduced number of HARQ processes

4□ serving cell RRM relaxation for stationary devices

5□ Coverage recovery

2 – VODAFONE Group Plc

Thank you for your contribution.

What is your view regarding PUSCH resource fragmentation by further decreasing the bandwidth to 5MHz? Is there any other concerns regarding the coexistence with legacy RedCap UEs and non-RedCap UEs?

3 – Spreadtrum Communications

Thank for the answers from 1st round. We share the same view with Huawei that BW reduction plays a key role for R18 cost reduction.

On spectrum efficiency improvement for industrial factory scenario, could you clarify a bit more on reduction of collisions or reduction of the interference between multiple-user transmissions? Thanks.

4 – Ericsson LM

Regarding further reduced UE bandwidth to 5 MHz (including various other further UE complexity reduction techniques), is it correctly understood that your estimates of 7-15% concern the reduction compared to the Rel-17 RedCap UE (not compared to the Rel-15 reference NR device)?

5 – Sierra Wireless

WRT a 5MHz RedCap device - We are not supportive of creating yet another LPWA device type, for many reasons.

No Market – We feel a 5MHz Redcap device will further fragment the Redcap and NB-IOT/CAT-M1 market and not grow the TAM. A 5MHz Redcap device can only operate with SCS=15MHz unless massive standard changes are implemented - this further limits TAM. The Cat-M2 5 MHz device type which is

similar to what is being proposed has never been commercialized as no market has materialized – NB-IOT,CAT-M1 and CAT1Bis are enough to fulfill the market need. Why is Redcap different? Can you please elaborate on increase in TAM for such a 5MHz RedCap device?

Consider a smaller ScalingFactor (e.g. 0.1) - using the already specified ScalingFactor of 0.4,will bring the peak rate of a Rel17 Redcap down to 34mbps which is already close enough to Cat1Bis in our view. But if lower is needed, specifying a new scaling factor of e.g. 0.1 would bring this down to Cat1bis speeds. Would you consider only changing the ScalingFactor?

Minimal Cost savings: Contrary to TR 38.875 which assumes a single band device as a reference, the industry has shown that reducing bandwidth for real world multi-band devices is not a significant way to reduce cost. If the peak rate is reduced e.g. using a small ScalingFactor, your predicted 7-15% cost of goods reduction compared from Redcap Rel17 will not occur. Please comment?

6 – CATT

Thanks for your response. Can you elaborate a bit more on 'Relax the timing relationships of HARQ procedures' in your paper (RWS-210444), if it does not refer to relaxed processing time?

7 – QUALCOMM JAPAN LLC.

[Qualcomm]

Thanks for your response. Regarding your comments on supporting SSB w/ 30 kHz SCS by an max UE BW of 5 MHz, could you please clarify how to enable it by implementation-based solution ? Do you expect any RAN4 impact for such implementation ? How about the SCS selection for RMSI of R18 eRedCap UE ?

3.4.1 Answers

Feedback Form 24: Answers from Huawei to questions and comments on RWS-210444

1 – Huawei Tech.(UK) Co.. Ltd

1 – vivo Communication Technology

Q1: Regarding further reduced UE RF BW, it is expected that performance degradation will occur in both link level (less frequency diversity) and system level (less frequency selective gain, and more resource fragmentation),we wonder whether and how to compensate these performance degradation, and will the potential solutions increase the UE complexity?

□A1□Since the target is mid-tier IoT with low data rate of a few Mbps, thus it not necessarily the case that there will be performance degradation for reduced UE bandwidth since the data rate requirement may reduce. We think the framework being developed in R17 could be applied for further reduced BW UE, thus we don't foresee UE complexity increasing.

Q2:For redcap positioning accuracy, we understand that frequency hopping by RF retuning may be possible. But in this case, it's hard to ensure the phase consistency among different frequency hops. However, the positioning accuracy is very sensitive to phase inconsistency, not sure what additional method can be provided to ensure phase consistency and then achieve high accuracy.

□A2□Thanks for the comment. We have the same view on the phase inconsistency issue among different frequency hops, and solving this would be part of the necessary work.

Q3: In addition to the BW reduction, we wonder what is your view on the following potential areas for

Rel-18 eRedCap?1

1 lower UE power class

2 UE Processing time relaxation (data, CSI)

3 Reduced number of HARQ processes

4 serving cell RRM relaxation for stationary devices

5 Coverage recovery

□A3□For #1, it would be good to understand what is the use case for RedCap first. For #2 and #3, these may give some complexity reduction, but since it would be less than by further reducing bandwidth, we think that should be supported first. For #4, this was discussed during SI and our understanding was serving cell RRM relaxation should have impacts on performance. For #5, whether there is a need for coverage recovery needs further investigation.

2 – VODAFONE Group Plc

Thank you for your contribution.

What is your view regarding PUSCH resource fragmentation by further decreasing the bandwidth to 5 MHz?

Is there any other concerns regarding the coexistence with legacy RedCap UEs and non-RedCap UEs?

□A1□Thanks for the question. We also share the view that resource fragmentation is import for coexistence between RedCap and non-RedCap UEs. It is being discussed in R17 and we think the framework to avoid or minimize resource fragmentation achieved in R17 could be applied for further reduced BW UE.

3 – Spreadtrum Communications

Thank for the answers from 1st round. We share the same view with Huawei that BW reduction plays a key role for R18 cost reduction.

On spectrum efficiency improvement for industrial factory scenario, could you clarify a bit more on reduction of collisions or reduction of the interference between multiple-user transmissions? Thanks.

□A1□In a factory, a particularly high density of UEs may be deployed, and the dominant traffic from them is uplink. This means that shrinking the overheads for RedCap in such scenarios is motivated in our view, although it of a lower priority than introducing the mid-tier further reduced BW UE. This part has lower priority than others in our paper.

4 – Ericsson LM

Regarding further reduced UE bandwidth to 5 MHz (including various other further UE complexity reduction techniques), is it correctly understood that your estimates of 7-15% concern the reduction compared to the Rel-17 RedCap UE (not compared to the Rel-15 reference NR device)?

□A1□The baseline of 100% is same as eMBB UE. We meant in the 1st round reply that since the cost of eMBB is a high baseline, thus the 7-15% additional saving is still meaningful in absolute cost.

5 – Sierra Wireless

WRT a 5MHz RedCap device - We are not supportive of creating yet another LPWA device type, for many reasons.

No Market – We feel a 5MHz Redcap device will further fragment the Redcap and NB-IOT/CAT-M1 market and not grow the TAM. A 5MHz Redcap device can only operate with SCS=15MHz unless massive standard changes are implemented - this further limits TAM. The Cat-M2 5 MHz device type which is

similar to what is being proposed has never been commercialized as no market has materialized – NBIOT,CAT-M1 and CAT1Bis are enough to fulfill the market need. Why is Redcap different? Can you please elaborate on increase in TAM for such a 5MHz RedCap device?

Consider a smaller ScalingFactor (e.g. 0.1) - using the already specified ScalingFactor of 0.4,will bring the peak rate of a Rel17 Redcap down to 34mbps which is already close enough to Cat1Bis in our view. But if lower is needed, specifying a new scaling factor of e.g. 0.1 would bring this down to Cat1bis speeds. Would you consider only changing the ScalingFactor?

Minimal Cost savings: Contrary to TR 38.875 which assumes a single band device as a reference, the industry has shown that reducing bandwidth for real world multi-band devices is not a significant way to reduce cost. If the peak rate is reduced e.g. using a small ScalingFactor, your predicted 7-15% cost of goods reduction compared from Redcap Rel17 will not occur. Please comment?

□A1□We think many IoT use cases which require data rates of a few Mbps are cost-sensitive, and will not be addressed by R17 RedCap devices. Thus, we think 5MHz RedCap device can increase TAM for NR, including part of the migration from Cat1bis as well as those cases that Cat1bis cannot address, e.g. power consumption etc. Scaling factor can save data buffer size, but reduced UE bandwidth can save more, which is critical for the competitiveness of NR. A 5 MHz Cat-M2 UE is not commercialized in LTE, but this does not mean 5MHz RedCap UE has no value for NR. Our estimation follows the methodology defined in the TR.

6 – CATT

Thanks for your response. Can you elaborate a bit more on 'Relax the timing relationships of HARQ procedures' in your paper (RWS-210444), if it does not refer to relaxed processing time?

□A1□Our paper does not include any proposal on relaxation of HARQ procedures. We listed a number of techniques that have been proposed, to set the context of the discussion in our paper.

7 – QUALCOMM JAPAN LLC.

[Qualcomm]

Thanks for your response. Regarding your comments on supporting SSB w/ 30 kHz SCS by an max UE BW of 5 MHz, could you please clarify how to enable it by implementation-based solution ? Do you expect any RAN4 impact for such implementation ? How about the SCS selection for RMSI of R18 eRedCap UE ?

□A1□Implementation-based solution to skip some part of the SSB was discussed (by other companies) for FR2 in R17. Thus at least puncturing could be used for 30kHz SCS SSB. Whether an implementation solution would have any RAN4 impact and SCS selection for RMSI is worth further study.

3.5 RWS-210445 NR sidelink and V2X enhancements

Feedback Form 25: Further questions on RWS-210445

1 – ROBERT BOSCH GmbH

Q1: Can you please elaborate more on the benefits of Mode 1 / Mode 2 (in coverage) pQoS ? is it only for handover scenario ? In mode 2, does it consider Sidelink collision as well ?

Q2: let us combine Redcap and SL enhancements question to make it clearer. If you can support sidelink for RedCap (if time permits), do you support that RedCap with SL capability to be used in V2X use cases(e.g., VRU like eBike/2-wheeler)?.

E.g., Therefore a u-Mobility will have a RedCap ECU with SL (communicating it to vehicles/Infrastructure) and Uu (connecting it to a gNB).

2 – LG Electronics Inc.

Q1: Can you provide your view on so called "licensed-assisted" and "unlicensed standalone" operations?

Do you think SL access to unlicensed band in Rel-18 needs to support a case where SL on a licensed carrier is used for some assistance and/or another case where SL access to unlicensed band is done with no assistance from other carriers?

Q2: SL on over unlicensed band was suggested in Proposal 1 but Proposal 5 seems to cover only ITS and licensed bands for SL positioning. What is your view on SL positioning support on unlicensed band as a topic in Rel-18?

3 – Samsung Electronics Co.

Q1: We agree that FR2 provides more BW than FR1. However, SL is not optimized for operation in FR2, for example SL doesn't support beam-based operation. Would a more reliastict approach be that in Rel-18 the focus is support of general SL in FR2, and/or support of SL-U in FR1. In a later release SL-U support can be extended to FR2.

Q2: For proposal 7 and 8 should QoS include incoverage, partial coverage and out of coverage scenarios?

4 – Philips International B.V.

We agree with your proposal 2 about supporting power saving enhancements on Sidelink. We are wondering if it would be simpler to support LTE-M on Sidelink Relays.

The reason to ask this is because we are currently working in some Health wearables using LTE-M. We have very recently realized that LTE-M, in practice, does not offer better coverage than LTE and, in some scenarios, even less coverage. The reason why is that CE Mode B is not deployed in the field (several reasons for this, the main one being that LTE-M uses LTE resources and enabling many repetitions will take too much resources from LTE and make the base stations schedulers quite complex) and a wearable device has a negative antenna gain that cancels the gains of CE Mode A of LTE-M. All this leaves LTE-M evern below the coverage offered by LTE. One can argue that you can instead use NB-IoT but NB-IoT does not fulfill the same use cases as LTE-M. Likewise I expect that the coverage of RedCap is limited (although I am not fully up to date with the WI NR Coverage enhancements). We think that supporting LTE-M (and maybe NB-IoT and RedCap) within the Relay ecosystem could greatly improve the coverage. This is not new to 3GPP. During the Rel-16 preparation a SID (RP-180750) along these lines was proposed by several companies but in the end it did not have enough traction. Back then the arguments to promote this SID were different and the lack of coverage of LTE-M was not among them. Considering all this, what is your view on supporting LTE-M (and maybe NB-IoT and RedCap) on Sidelink Relays?

3.5.1 Answers

Feedback Form 26: Answers from Huawei to questions and comments on RWS-210445

1 – Huawei Tech.(UK) Co.. Ltd

1 – ROBERT BOSCH GmbH

Q1: Can you please elaborate more on the benefits of Mode 1 / Mode 2 (in coverage) pQoS ? is it only for handover scenario ? In mode 2, does it consider Sidelink collision as well ?

Answer: The prediction results can be used for handover optimization, but it is in general useful for real-time network management, e.g. radio resource management, in order to improve the QoS performance and increase the reliability of the radio link. In addition, the prediction results can be sent to vehicle application, as pre-notification of the QoS change. In mode 2, if QoS degradation is predicted as the consequence of congestion, mitigations can be applied to reduce the sidelink collision.

Q2: let us combine Redcap and SL enhancements question to make it clearer. If you can support sidelink for RedCap (if time permits), do you support that RedCap with SL capability to be used in V2X use cases(e.g., VRU like eBike/2-wheeler)?.

E.g., Therefore a u-Mobilitywill have a RedCapECU with SL(communicatingit to vehicles/Infrastructure) and Uu (connecting it to a gNB)

Answer: Thank for the example of your proposal. We would need to see more analysis of requirements and use cases in order to reach a conclusion on feasibility and necessity.

2 – LG Electronics Inc.

Q1: Can you provide your view on so called "licensed-assisted" and "unlicensed standalone" operations? Do you think SL access to unlicensed band in Rel-18 needs to support a case where SL on a licensed carrier is used for some assistance and/or another case where SL access to unlicensed band is done with no assistance from other carriers?

Answer: We think "licensed-assisted" refers to the case that, for example, control signaling, (re-)configuration messages, etc., can be performed on the licensed band to assist data communication over the unlicensed band. "Unlicensed standalone" refers to the case that sidelink can independently operate over the unlicensed band. Both cases can be considered in Rel-18.

Q2: SL on over unlicensed band was suggested in Proposal 1 but Proposal 5 seems to cover only ITS and licensed bands for SL positioning. What is your view on SL positioning support on unlicensed band as a topic in Rel-18?

Answer: As Rel-16/17 sidelink designs are over ITS bands (e.g. n47) and licensed bands (e.g. n14, n38, n79), we think sidelink positioning should be based on the existing sidelink framework at this stage, and can be further enhanced to include unlicensed bands after the fundamental sidelink design for those is in place.

3 – Samsung Electronics Co.

Q1: We agree that FR2 provides more BW than FR1. However, SL is not optimized for operation in FR2, for example SL doesn't support beam-based operation. Would a more reliastict approach be that in Rel-18 the focus is support of general SL in FR2, and/or support of SL-U in FR1. In a later release SL-U support can be extended to FR2.

Answer: The main reason for modification on sidelink design for operating over unlicensed spectrum is due to channel access subject to regulations, regardless of frequency ranges. The WI on extension of Uu to 71 GHz is being completed within one Release. Thus we think SL-U in FR1 and FR2 (or FR2-2) should be jointly considered with a unified framework. This would also have the advantage that the FR2 enhancement would be designed to work in unlicensed from the beginning, rather than needing potentially more complex changes for that purpose in a later release.

Q2: For proposal 7 and 8 should QoS include incoverage, partial coverage and out of coverage scenarios?

Answer: Our proposal 7 focuses on Uu only. Proposal 8 considers both sidelink Mode 1 and Mode 2, under in-coverage, partial coverage and out-of-coverage scenarios.

4 – Philips International B.V.

We agree with your proposal 2 about supporting power saving enhancements on Sidelink. We are wondering if it would be simpler to support LTE-M on Sidelink Relays.

The reason to ask this is because we are currently working in some Health wearables using LTE-M. We have very recently realized that LTE-M, in practice, does not offer better coverage than LTE and, in some scenarios, even less coverage. The reason why is that CE Mode B is not deployed in the field (several reasons for this, the main one being that LTE-M uses LTE resources and enabling many repetitions will take too much resources from LTE and make the base stations schedulers quite complex) and a wearable device has a negative antenna gain that cancels the gains of CE Mode A of LTE-M. All this leaves LTE-M evern below the coverage offered by LTE. One can argue that you can instead use NB-IoT but NB-IoT does not fulfill the same use cases as LTE-M. Likewise I expect that the coverage of RedCap is limited (although I am not fully up to date with the WI NR Coverage enhancements). We think that supporting LTE-M (and maybe NB-IoT and RedCap) within the Relay ecosystem could greatly improve the coverage. This is not new to 3GPP. During the Rel-16 preparation a SID (RP-180750) along these lines was proposed by several companies but in the end it did not have enough traction. Back then the arguments to promote this SID were different and the lack of coverage of LTE-M was not among them. Considering all this, what is your view on supporting LTE-M (and maybe NB-IoT and RedCap) on Sidelink Relays?

Answer: Thanks for the comments and questions. Our proposal 2 is intended to extend Rel-17 NR sidelink design to further reduce power consumption, rather than to redesign LTE LPWA to have a sidelink.

3.6 RWS-210446 NR multicast broadcast enhancements

Feedback Form 27: Further questions on RWS-210446

1 – ZTE Corporation

Thanks for the reply and clarifications. We have some further questions as below:

Considering your reply on the FTA "in order to share the capabilities for unicast and FTA, as specified in LTE, the UE should report the capability reduction for unicast due to FTA carrier reception and so on and this may not be able to be supported in Rel-17", we have following questions:

- will UE have to report its capability and MBS interests anyway as in LTE in current Release?

- or are you indicating there will be some FTA "dedicated" carrier in NR (like MBMS dedicated cell in LTE? This however can be supported by current NR framework, we believe), this is something more than capability indication. It seems companies are not on the same page about the FTA impacts on RAN.

In the 1st round of discussion, you mentioned that MBSFN and unicast can be supported at least in TDM manner. Do you consider FDMed MBSFN and unicast in the same cell?

Regarding the simulation results of SFN mentioned in your contribution (i.e., Figure 1), we have some detailed questions for clarification. Could you elaborate a little bit about the simulation assumptions, e.g., ISD, antenna configuration, indoor/outdoor UE distribution, beam configuration, etc. In addition, regarding the SINR gain for different SFN size, is the gain calculated based on cell-edge UE (e.g., 5% geometry)?

2 – CATT

Thanks for your response to our question in round 1.

one quick follow up: we are open to further discuss the gains/compleixty of sfn in R18 NR MBS topic.

Then we also agree with your explainations to other companeis on aspects such as FTA support.

3.6.1 Answers

Feedback Form 28: Answers from Huawei to questions and comments on RWS-210446

1 – HUAWEI TECHNOLOGIES Co. Ltd.

[Huawei, HiSilicon] Answers to ZTE second round questions.

Thank you for the further detailed questions. See our answers below.

Based on the current discussion in Rel-17, we assume MII report would include TMGIs received by the UE, but if these TMGIs are received from other operators, the network would have no idea about the detailed configuration of this service, for example of radio parameters such as bandwidth/SCS/MCS used for FTA service reception and so on. Thus, the network would not know how the UE's capability to receive services (either unicast or MBS) in the serving cells is impacted by receiving FTA on non-serving cells.

On deploying FTA "dedicated" carrier in NR, we think it might probably be supported by the current NR framework by barring UE or not broadcasting uplink carrier configuration and so on. However, it might have some impacts on the frequency prioritization during cell re-selection for the UEs which need to camp on normal frequency and receive MBS on FTA carrier simultaneously, this would depend on the outcome of Rel-17 discussion for broadcast service continuity.

1) FDMed MBSFN and unicast in the same cell is possible if we use same SCS/CP for SFN and unicast, this is already supported in Rel-17.

2) The simulation assumptions can be found below

- Channel model: Uma_A (3GPP TR 36.873)
- ISD = 1732m/700MHz carrier frequency
- BS Transmit power: 46 dbm
- BS effective antenna height 35m
- BS antenna gain 10.5dBi
- 95% UEs with BLER<1%
- Device deployment: 100% outdoor
- Number of antenna elements per TRxP: 4 Tx cross-polarized antennas, (M,N,P,Mg,Ng) = (8,2,2,1,1);
- Number of TXRU per TRxP: 4 TXRU: Vertical 1-to-8
- Number of antenna elements per UE: 2Rx with 0°,90° polarization
- Channel estimation: Non-ideal

[Huawei, HiSilicon] Answers to CATT second round Comments.

Thank you and we are happy that you are sharing our views.

3.7 RWS-210453 Passive IoT for 5G-Advanced

Feedback Form 29: Further questions on RWS-210453

1 – ZTE Corporation

Thanks for the interesting contribution.

We actually noticed that there was a similar proposal in SA1 to study the requirements of Wireless Power Sourcing enabled Communication Services (WPSCS) targeting for Rel-19. Could you please clarify the

relationship between the two proposals?

2 – vivo Communication Technology

[vivo]

Extending the receiving cycle (e.g., eDRX, PSM) can reduce the power consumption much lower than 1mW. However, we think the latency of wake-up is still important in some cases.

As you mentioned LPWAN, what is the main differences between the legacy LPWAN technology and this Passive IoT?

3 – Sony Europe B.V.

Thank you for your detailed and informative answers to the questions posted by companies.

Our understanding is that you are considering energy harvesting from the incident RF energy or from the instantaneous power available from other types of energy harvesting (e.g. if a solar panel provides 1mW of power, there is 1mW of power available for wireless communication). Do you also consider the case that energy can be collected by an energy harvesting device, stored (e.g. in a capacitor / small battery) and then used for wireless communication later (you could harvest 1mW of energy for 10 seconds and then transmit at 10mW for 1 second)? The implications of this mode of energy harvesting would be that there are finite amounts of replenishable energy available to the device, rather than that the device would have a low-level steady stream of power available?

3.7.1 Answers

Feedback Form 30: Answers from Huawei to questions and comments on RWS-210453

1 – Huawei Tech.(UK) Co.. Ltd

ZTE Corporation

Question 1:

Thanks for the interesting contribution. We actually noticed that there was a similar proposal in SA1 to study the requirements of Wireless Power Sourcing enabled Communication Services (WPSCS) targeting for Rel-19. Could you please clarify the relationship between the two proposals?

[Answer]

Wireless power sourcing is one kind of energy harvesting technique, in which energy is transferred from a source node to devices through RF signals. In this way, the source node can usually transmit information and power to devices simultaneously. There can also be many other energy resources being able to provide higher power than RF energy, such as solar energy for outdoor and illumination energy for indoor.

Energy harvesting may be the best way to support batteryless devices, which is required in many use cases. The high power consumption of existing cellular devices makes it hard for them to work with harvested energy rather than a battery. Consequently, passive IoT is an important direction for IoT evolution to open new markets for cellular networks. We think it is good to start study efforts on newer areas at an early opportunity to be ready for the market.

vivo Communication Technology

Question 1:

Extending the receiving cycle (e.g., eDRX, PSM) can reduce the power consumption much lower than 1mW. However, we think the latency of wake-up is still important in some cases.

As you mentioned LPWAN, what is the main differences between the legacy LPWAN technology and this Passive IoT?

[Answer]

It appears that "the power consumption much lower than 1mW" mentioned in the question is about average power consumption. However, the instantaneous power required by devices is a limiting factor. For example, if illumination energy is harvested for devices with a size of several square centimeters, the output power of an energy harvester would probably be tens of or around a hundred microwatts. It means that power consumption of the device is better not to exceed 1 mW for transceiving processing. We agree that one benefit of passive IoT is that there is no latency of wake-up as the devices can stay in active mode, benefiting from the ultra-low power consumption for transceiving.

For LPWA, since the fundamental principles of the UE have not been changed, the power consumption of LPWA devices is still as high as tens of milliwatts for transceiving. The low power consumption mainly refers to the average power consumption, which is significantly reduced through eDRX and PSM for LPWA devices. Passive IoT aims to support batteryless devices for some use cases. Energy harvesting may be the best way to enable batteryless devices. To work with the ultra-low power provided by energy harvesting, the power consumption of transceiving needs to be lowered by hundreds of times compared with LPWA devices. Energy detection for downlink receiving and backscattering modulation for uplink transmitting can achieve power consumption at microwatts level. The two techniques also enjoy very simple implementation, which may reduce the device cost by ten or a hundred times compared with LPWA.

Sony Europe B.V.

Question 1:

Thank you for your detailed and informative answers to the questions posted by companies.

Our understanding is that you are considering energy harvesting from the incident RF energy or from the instantaneous power available from other types of energy harvesting (e.g. if a solar panel provides 1mW of power, there is 1mW of power available for wireless communication). Do you also consider the case that energy can be collected by an energy harvesting device, stored (e.g. in a capacitor / small battery) and then used for wireless communication later (you could harvest 1mW of energy for 10 seconds and then transmit at 10mW for 1 second)? The implications of this mode of energy harvesting would be that there are finite amounts of replenishable energy available to the device, rather than that the device would have a low-level steady stream of power available?

[Answer]

We agree that storing harvested energy for a long time to provide higher output power for a short time is a good way of utilizing energy harvesting.

If the power consumption of devices can be at the level of several or tens of microwatts, the required capacitance of a capacitor to store this energy can be as low as tens of micro-farads. The leakage current of the capacitor is usually negligible, while the cost can be as low as $0.01. This gives the ultra-low power design also the advantage of ultra-low cost.

Such capacitors seem preferable to e.g. rechargeable lithium batteries, which can require a stable current or voltage for a long time in order to charge, which cannot be provided by energy harvesting.

3.8 RWS-210454 UE reliability

Feedback Form 31: Further questions on RWS-210454

1 – ROBERT BOSCH GmbH

Answer to question Q3:

Thank you for your answers. In our understanding TSCAI is indicated by higher layer if survival time need to be identified in the QoS flow (TS 23.501). According to SA1 TS 22.104, expiry of survival time leads to communication service failure or fail safe, which is a procedure indicating the ”open” channel to be unavailable. This procedure is needed in for FuSa related application, which has a specific safety integrity level (SIL). Therefore, URLLC which has a TSCAI QoS flow indicator is dedicated for Functional Safety (FuSa) traffic, i.e., and not every URLLC traffic.

Answer regarding pQoS:

- my understanding is that you assume a UE failure (software or what ever, and, afterwards, you will trigger UE backup to send the same data. My understanding this can also be for link failure, e.g., survival time expires.

- However, if the system can predict the QoS deterioration of UE link, it can extend its transmission through a second and third you.

Q1: do you consider UE backup for sidelink as well?

Q2: do you consider more cases backup (e.g., chase combining, network coding, multiplexing data/rate split, duplication, etc.)?

3.8.1 Answers

Feedback Form 32: Answers from Huawei to questions and comments on RWS-210454

1 – HuaWei Technologies Co.

Thanks for your answers. We understand you are considering to have QoS monitoring for each UE, and once one UE’s QoS continuously becomes worse, the takeover procedure can be triggered. If this is the case, we agree UE backup also can be used for not only UE breakdown but also link deterioration.

Q1: do you consider UE backup for sidelink as well?

Thanks for your question. Do you mean the backup UE has sidelink interface with the other UE, it is more like a relay UE? We think most of the current URLLC traffic mainly operates on Uu interface, and the backup UE can have sidelink interface with the other UE. The sidelink interface can be used for UE breakdown detection or some assistant information to help the network timely detect the failure or trigger the takeover procedure.

Q2: do you consider more cases backup (e.g., chase combining, network coding, multiplexing data/rate split, duplication, etc.)?

Thanks for your question. What we focused here is whether we should have visibility of the two backup UEs to the network and make corresponding enhancements. For duplication and data split of two UEs, this

was discussed in our paper RWS-210451; for other techniques you mentioned, we understand it does not require specific handling on two UEs, it is rather a radio interface enhancement for a single UE and some of them has already been supported, this can be discussed case by case to verify the gains.

4 Summary and conclusions

RWS-210439 5G-Advanced XR

Many companies provided comments and there is wide interest and support to consider XR enhancements.

The following aspects have been discussed:

The majority of the companies are interested and also show support for the motivation of E2E layered QoS mechanism. The questions mainly focus on specific impact of the E2E layered QoS mechanism. Clarification has been made that identification of importance of packets can be considered for the case with single QoS flow, and the association of relevant flows can be considered for the case with multiple QoS flows. In addition it is also clarified this work needs involvement of SA.

The majority of the companies show their interests and support the motivation of E2E frame level integrated transmission. The questions mainly focus on whether and how SA groups are involved. Clarification has been made that such E2E mechanism can proceed in parallel in RAN and SA, with coordination between RAN and SA as usual.

Quite a few companies are interested in definition of the metric of XQI. The questions mainly focus on the motivation for defining such a metric and the additional work compared with R17 QoE WI. Clarification has been made that this new metric is intended to reflect the impact of network transmission on user experience for XR services, which can be used for network planning and optimization or even scheduling. To define such a metric, some XR-specific information, which may be useful for XR quality evaluation in RAN, can be discussed and identified with coordination between RAN2/3 (e.g. QoE) and SA4.

RWS-210442 Complementary TDD and URLLC enhancements for NR

The discussion mainly focused on clarifications on details of the proposals/views in the paper, e.g. motivations for complementary TDD, how to solve inter-operator cross-link handling for complementary TDD, whether/how to support half-duplex UE for intra-band complementary TDD, potential standard impacts for complementary TDD, whether to include complementary TDD in URLLC WI or full-duplex SI, details of CSI enhancements for tracking more accurate interference, impacts on gNB/UE implementation by flexible initial transmission and re-transmission on different serving cells, details of PDCCH enhancements and what enhancements are needed for selective PDCP duplication/higher-layer redundancy. As we clarified that complementary TDD has common aspects with sub-band full duplex at least from interference management perspective, it can be further discussed in which SI/WI to include complementary TDD.

RWS-210443 NR LPHAP and other NR positioning enhancements

Clarifications were provided on the power efficiency (battery life) and low complexity targets (LPHAP requirements from SA1), and in particular it was explained how decoupling communication bandwidth and positioning bandwidth, and methods to achieve even lower power consumption in sleep mode, can help reach those targets in particular by saving on baseband processing. There were questions on the relation with RedCap positioning proposals, which would need to be further discussed once targets and requirements are clearly defined. It was clarified that the LPHAP proposal is not related to sidelink positioning nor to “passive

IoT". Clarifications were also provided on questions about positioning area.

RWS-210444 REDCAP enhancements

The main discussion related to the proposal for a further reduced RedCap UE bandwidth, and the cost saving this might have. Using the methods of TR 38.875, the proponent company explained that the saving is 7-15% relative to the Rel-15 eMBB UE. There were questions about how, if the reduced bandwidth was 5 MHz, would SSB with 30 kHz SCS be handled. Interest was shown in positioning for RedCap devices, and what enhancements could be considered given the restrictions on the RedCap UE bandwidth from Rel-17. An example given was using frequency hopping to approach the 100 MHz BW accuracy.

RWS-210445 NR sidelink and V2X enhancements

The two most-discussed points were:

For SL unlicensed, the main discussion was whether it should include FR2 in the same release as FR1, and whether there would be licensed-assisted FR1 sidelink operation on FR2. Additional questions were raised on whether to include SL positioning in unlicensed spectrum in the first release of sidelink unlicensed, or to add it later. These points seem worth discussing further.

For UE scheduling of other UEs' sidelink under mode 1, it was asked whether this was fully controlled by gNB, or allows the scheduling UE to make choices within the resources granted by gNB. It was clarified that the view is to allow both those operations.

RWS-210446 NR multicast broadcast enhancements

SFN support for inter-gNB/DU scenarios

Questions were raised about the expected numerology/CP for SFN, intended scenarios (inter-DU or inter-CU), network synchronization considerations for inter-sites scenarios. There were also some concerns about the complexity vs. benefits of Rel-18 SFN and the relation with LTE EnTV.

On numerology/CP for SFN, Huawei sees limited benefit of SFN even with Rel-15 numerology/CP, for example 15K SCS/normal CP, and extending CP to 16.7us for 15K SCS would harvest significantly more benefits in our view, but of course it would have some impact on UE hardware.

On intended scenarios and network synchronization, Huawei's view is that inter-gNB SFN for aggregated architecture should be supported and the same/similar solutions can be applied to both inter-DU and inter-CU case. We are open to discuss how to achieve network synchronization, for example by RAN based sync, LTE-like sync protocol, or even implementation based approaches.

On complexity vs. benefits of Rel-18 SFN, Huawei's view is that SFN is quite useful to improve spectrum efficiency and the reliability of reception for UEs at the cell edge. The main complexity stems from the requirement to ensure network synchronization. On numerology/CP for SFN, Huawei does see the benefit of SFN even with Rel-15 numerology/CP, for example 15K SCS/normal CP, and extending CP to 16.7us for 15K SCS would harvest significantly more benefits in our view, but of course it would have some impact on UE hardware.

On the relation between NR SFN and LTE EnTV, Huawei does not intend to introduce new smaller SCSs, as in LTE EnTV, for large area SFN, since it would bring huge impact on UE/Network hardware design and would probably be hard to commercialize. Hence, we are mainly considering to reuse existing SCS/CP and to introduce ECP for existing SCS for NR SFN to better utilize the NR ecosystem.

MBS broadcast optimization for FTA (free-to-air) deployment

Questions were raised about the expected RAN impacts for FTA, especially on what enhancements are needed for FTA on top of DM2 specified in Rel-17. There is also a concern on the "RAN solution name" to support FTA.

Huawei's view is that Rel-17 DM2/broadcast can in general be used to deploy FTA. However, in order to share the capabilities for unicast and FTA, as specified in LTE, the UE should report the capability reduction for unicast due to FTA carrier reception and it is yet unclear whether this will be supported in Rel-17. Therefore we need to provide a solution on RAN side for FTA. The naming (for example like ROM in LTE) is something that can be discussed later on.

MSB resources optimization in RAN sharing deployment

Some companies showed interest on this area and some companies expressed the view that RAN sharing for MBS should be supported in Rel-17 naturally and asked what standard impacts on RAN side we foresee to support RAN sharing.

Huawei's view is that Rel-17 MBS can work in RAN sharing scenario, but there is still a possibility to optimize the radio resources utilization in MOCN. For example, if one OTT server requests the same service delivery from multiple operators sharing a RAN network, several independent TMGIs will be allocated and RAN will treat these TMGIs as different services and thus allocate separate radio resources for each of them. As a consequence, the same contents/data will be transmitted multiple times. We think this duplicated transmission could be avoided if RAN was aware of such situation. If some simple approaches were specified for RAN to recognize the same service from different CNs, that would allow to reduce the radio resources consumption in MOCN deployments.

Rel-17 remaining issues including Multicast reception in RRC_INACTIVE/IDLE state

It seems most companies supported to standardize Multicast reception in RRC_INACTVE, and some companies expressed the view that SA2 has agreed to support only CM_CONNECTED for Multicast reception and thus RRC_IDLE should be excluded.

There were also detailed questions on Multicast reception in RRC_INACTIVE, for example how to perform feedback and how to guarantee the reliability/QoS of multicast in RRC_INACTIVE.

Huawei's view is that in Rel-17 the "multicast" is indeed supported only in NAS CM_CONNECTED, hence the support of multicast in IDLE would require also some work in SA2 in Rel-18. We are open to discuss whether to also support RRC_IDLE in addition to RRC_INACTIVE.

Since this enhancement is for network congestion scenario, we think it would be acceptable that reliability/QoS is worsened compared to multicast delivered for UEs in RRC CONNECTED state and that uplink feedback is not supported for such UEs.

Other issues

There was also a question on MR-DC support for Rel-18 MBS.

Huawei's view is that for NE-DC, Rel-17 MBS can be applied in NR MCG without extra standardization efforts and E-UTRAN SCG is not used for MBS delivery. For EN-DC we do not see the need for NR MBS, as it would require supporting NR MBS in S1 interface. For NR-DC, we are open for discussion. If there is a commercial requirement for this scenario we think this could be specified in Rel-18.

RWS-210453 Passive IoT for 5G-Advanced

There was discussion of timeline for studying to enable passive IoT. The view from the proponent company is that it's good to start study efforts on newer areas at an early opportunity to be ready for the market, particularly where there could be non-3GPP candidates in the same space. Discussion of how to structure a project in RAN on passive IoT would be worthwhile.

Other main questions focused on how much power consumption, and what sort of energy storage, is envisaged for passive IoT devices. The target is 1 – 100 uW power consumption so that a very low-cost storage such as a capacitor can be used.

RWS-210454 UE reliability

Companies provided comments on this contribution and most of them showed interest on UE reliability for Rel-18. The following aspects were asked and clarified:

The backup relationship between UEs should be identified by network (RAN level or CN level).

The taking over should be finished at least within survival time level. To achieve this, fast detection of UE failure is necessary and it could be based on Uu interface, or PC5 interface if it exists.

To ensure no data loss and low latency during taking over, SN synchronization mechanism between UEs should be studied so that backup UE can transmit unsent packets of breakdown UE, and fast switch mechanism also should be studied.

In summary, we see that companies have interest on the motivation of UE reliability and some companies have already considered detailed mechanism design.