

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

**RWS-210644**

**Electronic Meeting, June 28 - July 2, 2021**

**Agenda Item: 4.3**

**Source: Moderator (Spreadtrum)**

**NWM Tdoc title: RAN-R18-WS-crossFunc-Spreadtrum**

**Document for: Discussion and decision**

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## **1 Introduction**

According to Chair's guidance [1], this email discussion summary is to collect questions/comments for RAN-R18-WS-crossFunc, together with answers to classified and summarized questions/comments that are provided by moderator (Spreadtrum) in an organized manner.

This summary covers the following documents:

RWS-210063, Consideration on R18 AI/ML enabled RAN enhancement

RWS-210064, UE power saving enhancements for R18

RWS-210065, NR positioning enhancements for R18

RWS-210066, MBS enhancements for R18

RWS-210067, IIoT/URLLC enhancements for R18

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## **2 Comments/Questions/Answers to the Tdocs**

### **2.1 General comments**

#### **2.1.1 <1st Round> Comments**

In this contribution, from Spreadtrum's view, we list the cross-Functionalities for both eMBB and non-eMBB that we believe are important for R18.

Following RAN chair suggestion on RAN reflector, the Table 2.1.1 is to collect general comments/view on cross-Functionalities for both eMBB and non-eMBB from companies.

## Feedback Form 1: Table 2.1.1 General comments

### 1 – Spreadtrum Communications

From Spreadtrum's view, the cross-Functionalities for both eMBB and non-eMBB that we believe are important for R18 include the following topics:

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AI/ML enabled PHY enhancement, Power saving, Positioning, MBS, IIOT/URLLC

### 2 – Nokia Corporation

Thank you for the contribution, some questions for clarification below:

Q1: What is proposed by trajectory prediction, e.g., is it only x,y coordinates of the UE geographically?

Q2: What is the intended use case of the trajectory prediction in mobility?

Q3: Which part of the beam management procedure is proposed to be simplified and how?

#### 2.1.2 <1st Round> Answers by moderator

Many thanks to **Nokia** for your valuable questions and comments on R18 AI enabled RAN/PHY enhancement in 1<sup>st</sup> round. The corresponding answers/clarifications are provided below.

#### **Answer to Q1:**

The intention of trajectory prediction in our opinion is for L1/L2 BM use case. In our opinion, the trajectory could be a regional position, e.g., beam area. But it also could be x,y coordinations of the UE. With what we have said, we are open to this issue at current stage.

#### **Answer to Q2:**

The use case is for L1/L2 BM use case.

#### **Answer to Q3:**

In our opinion, at least beam training procedure could be simplified. For example, w/o AI all of beam pairs are needed to be trained, but leveraging AI perhaps a few of beam pairs are needed to be trained. In addition, frequent beam indication also could be saved.

## 2.2 AI/ML enabled PHY enhancement

### 2.2.1 <1st Round> Comments

In the contribution RWS-210063, we share some considerations on AI/ML enabled PHY enhancement with the following proposals:

***Proposal: Study and evaluate AI enabled PHY enhancement***

***- Identify use case(s) and deployment scenario(s)***

- E.g., CSI feedback, channel estimation, UL/DL RS overhead reduction, positioning, BM and mobility
- Study evaluation methodology for AI based solutions
- E.g., data set construction, AI model, AI algorithm, performance baseline
- Study and evaluate the benefit and requirement in the way of case by case
- Study potential standard impacts for use case(s) when identified to be beneficial

Regarding the above proposals for R18 AI/ML enabled PHY enhancement and RWS-210063, the Table 2.2.1 is to collect questions/comments from companies.

**Feedback Form 2: Table 2.2.1 [AI/ML enabled PHY enhancement] Questions/comments**

<p><b>1 – China Telecommunications</b></p> <p>Thanks for the proposals, we are also interested in AI/ML enable RAN enhancement, and we think there is a lot of research space on AI based CSI feedback and channel estimation. Meanwhile, we have some questions about your slides which need further clarification:</p> <p>Question: Regarding to AI based mobility enhancement (such as trajectory predication), which was listed as a potential use cases in Page3, we notice that it is also a key use case being discussed in <i>Enhancement for Data Collection for NR and EN-DC SI (RP-201620)</i>, so we are not sure if there is any relationship between them? And if physical layer and higher layer both specify the AI enabled mobility solutions, what is the focus of the physical layer solutions, and whether coordination is needed between the physical layer and high layer?</p>
<p><b>2 – Rakuten Mobile</b></p> <p>Thanks for contribution.</p> <p>We support AI/ML to be used for further enhancement in physical layer from interference , mobility , beam management etc. point of view.</p>
<p><b>3 – Sony Corporation</b></p> <p>Thanks for the contribution. We have a question.</p> <hr/> <p style="margin-left: 20px;">-</p> <p style="margin-left: 40px;">Data set construction</p> <hr/> <p style="margin-left: 40px;">o</p> <p style="margin-left: 60px;">How do you assume the data set to be used? For example, gNB only uses the data set, or both of gNB and UEs use the data set for training and inference?</p>

2.2.2 <1st Round> Answers by moderator

Many thanks to **CTC/Rakuten Mobile/Sony** for your valuable questions and comments on R18 AI enabled RAN/PHY enhancement in 1<sup>st</sup> round. The corresponding answers/clarifications are provided below:

@CTC,

Thanks for sharing your opinions on AI/ML enabled in PHY, and questions on trajectory predication. Regarding trajectory predication, the intention of our paper is mainly for L1/L2 BM use case. From our perspective, in Rel-17 Enhancement for Data Collection for NR and EN-DC(RP-201620) SID more focuses on high layer, e.g., using trajectory predication for HO. The difference between PHY layer and High layer may lie in the granularity of trajectory predication, e.g., the level of beam area for PHY layer, the level of cell area for High layer. We think the data set for trajectory predication or related training/inference could be shared to some extent between PHY layer and High layer although they are targeting different use cases, and coordination may be needed.

**@Rakuten Mobile,**

Thanks for sharing your opinions. Glad to see that we both are interested in AI/ML enabled PHY layer enhancement. From our perspective, there are three stages for AI plus 5G: 5G for AI, AI for 5G, and intrinsic AI in 5G. The first two have been commercial successes nowadays. It is proper time to start the study at intrinsic AI in 5G to empower better 5G Advanced.

**@Sony,**

Thanks for your questions on data set utilization. We think that how to use data set may depend on specific use case. For example, for the use case of channel estimation, only UEs use the data set for training and inference. While for the use case of CSI compression and recovery, both gNBs and UEs may use the data set for training and inference. With what we have said, we are open to this issue at current stage.

### 2.2.3 <2nd Round> Comments/Questions

The 2<sup>nd</sup> round discussion targets clarifications to answers by moderator in section 2.2.2 and further clarifications on RWS-210063 together. Please share your further questions/comments/views in the following Table 2.2.3.

**Feedback Form 3: Table 2.2.3 [AI/ML enabled PHY enhancement][Second round] Questions/comments/views**

**1 – China Telecommunications**

Thanks for the response, we think it worth to study the AI/ML enabled PHY enhancement on mobility enhancement, coordination with high layer solutions can be further discussed as well.

2.2.4 <2nd Round> Answers by moderator

@CTC, many thanks for sharing your views. L1/L2 based intra-cell and inter-cell mobility has been covered in original R17 FeMIMO WID. However, due to limited TU budget, RAN#92e decided that only the case where the serving cell is not changed is supported, and the case where the serving cell can be changed is delayed. From our perspective, L1/L2 mobility is beneficial to improve mobility performance. In Rel-18, it is worthy to specify L1/L2 inter-cell mobility, and study AI based PHY mobility.

2.3 Power saving enhancements

2.3.1 <1st Round> Comments

In the contribution RWS-210064, we share some considerations on power saving enhancement with the following observations and proposals:

***Observation 1: The power saving gain of the LP-WUS with RRM measurement relaxation for serving cell is considerable compared to R17 PEI.***

***Observation 2: The candidate schemes of R17 PEI can be down selected as well, which is independent of the LP-WUS in future releases.***

***Proposal 1: Consider to specify the enhancements for secondary DRX group in R18.***

***Proposal 2: Consider to specify the enhancements for DRX for intensive traffic in R18.***

***Proposal 3: Consider to specify the enhancements for DRX for UL dominated traffic in R18.***

***Proposal 4: Consider to specify the enhancements for PDCCH monitoring reduction for UL dominated traffic in R18.***

***Proposal 5: Identify the overlapping points between power saving and the other topics in R18, and then decide whether to specify them in power saving topic or the other topics.***

***Proposal 6: Consider to study the low-power WUS in R18, and both feasibility and necessity should be addressed.***

Regarding the above proposals for R18 power saving and RWS-210064, the Table 2.3.1 is to collect questions/comments from companies.

**Feedback Form 4: Table 2.3.1 [Power saving] Questions/comments**

**1 – MediaTek Inc.**

Thanks for the quality contribution on further UE power consumption enhancements. Below please find our questions/comments:

On **Proposal 1**, interaction between 2nd DRX and other connect-mode DCI-based power saving features was discussed in previous RP meeting, and the decision is not to be discussed in R17. Major concern received is that 2nd DRX has little additional benefit when SCell dormancy and DCP/WUS are configured, and network may simply de-configure 2nd DRX to avoid the interaction issue. We hope this related information can be useful for further consideration of Proposal 1.

On **Proposals 2 - 4**, R17 enhancement on PDCCH monitoring reduction will provide a generic solution that can best deal with any dynamic and intensive DL/UL traffic since slot-wise power saving adaptation is feasible. Regarding various data traffic types, will configuring connected-mode DRX optimized for legacy FTP/Video traffic and applying DCI-based adaptation for new (CG/AR/VR) traffic be sufficient already?

On **Proposal 5**, we are supportive to this principle, as was done in the scoping of R17 items.

On **Proposal 6**, we agree that WUR can provide additional power saving gain under the condition that serving cell RRM can be relaxed. The condition has been discussed in R16 UE power saving scoping and R17 REDCAP scoping, but there is still no consensus on serving cell RRM measurement relaxation. Identifying a new use case/scenario there we can relax serving-cell RRM measurement looks the critical check point before further investigation to feasible WUR designs.

**2 – CATT**

For proposal 1, the benefit of UE power saving and specification complexity of feature interaction had been discussed in RAN, RAN1, and RAN2 without consensus. A new justification of UE power saving gain should be shown for further consideration

For Proposals 2/3/4, Rel-16/17 power saving techniques can support intensive traffic and associated DRX and UL dominant traffic.

The low power or passive receiver for power saving techniques had been proposed by CATT in Rel-15 with the proposal and architecture. We need to define the general framework for the study of low power/passive receiver.

**3 – China Telecommunication Corp.**

Thanks for the good contribution for UE power saving.

Sometimes, proposals for UE power saving are against to network energy efficiency. However, network energy saving is essential for environmental sustainability and reducing the high OPEX for 5G operators. How to limit the negative impact to network power consumption?

**4 – HUAWEI TECHNOLOGIES Co. Ltd.**

[Huawei/HiSilicon]

Comments to RWS-210064:

We share the same view that power saving for uplink-dominant traffic is important for Rel-18 considering that there are a lot proposals to enhance uplink performance in Rel-18 to meet the increasing traffic requirements in uplink. Regarding uplink-related power saving, are you considering both control signaling and data?

For the low-power radio, it is an important area for 3GPP to investigate. There are some technologies in common for application of low-power radio for power saving and for passive IoT applications.

#### **5 – Intel Corporation (UK) Ltd**

Q.1 What is the possible impact to the timers, such as Onduration, or inactivity-timer due to dynamic DRX adaptation?

#### **6 – Beijing Xiaomi Mobile Software**

*Comment(s) :*

*P1: Same concern with MTK, secondary DRX group was not agreed in R17.*

*P2: Agree the enhancement for XR*

*P6: We are interested in study it. But we have some concerns:*

*1) The new low power/passive receiver would bring extra implementation complexity to the UE. We should be cautious about this.*

*2) The gain of LP-WUR is coming from serving cell RRM measurement relaxation. Do you mean that LP-WUR is only for stationary UE? Or you want to use it for Redcap UE?*

#### **7 – Apple Italia S.R.L.**

Q1: for Proposal 2 and 3, do you have any specific DRX enhancements in mind?

Q2: for Proposal 4, what kind of PDCCH monitoring enhancements would be useful for UL heavy traffic on top of R17 enhancements?

#### **8 – vivo Communication Technology**

We agree with the necessity to study lower power wake up radio in Rel-18.

Other enhancement proposed in the contribution are mostly for RRC connected mode and highly overlap with the power saving enhancement in the XR item, do you think we can move such objectives (RRC connected mode powe saving) to XR item, or some of them should be included in a seperate UE power saving item?

#### **9 – Samsung Electronics Co.**

1. Is the ultra-low power WUS intended for long eDRX cycle?

2. One benefit mentioned in the contribution is reduce power of network synchronization. Can you clarify how that can be achieved? Any enhancement regarding mobility handling?

3. Besides the need of ultra-low power WUS, are there any other scopes/objectives to support ultra-low power wake-up receivers (WUR)? For example, new low power class for other signal/channel reception/-transmisison?

#### **10 – Sony Europe B.V.**

Proposal 6: What type of LP-WUS and architecture for WUR do you consider? We think it should be possible to perform RRM measurements via the low power WUR.

### 2.3.2 <1st Round> Answers by moderator

Many thanks to **MTK/CATT/CTC/Huawei/Intel/Xiaomi/Apple/vivo/Samsung/Sony** for your valuable questions and comments on R18 power saving in 1<sup>st</sup> round. The corresponding answers/clarifications are provided below:

**@MTK,**

Thanks for your kindly attentions and questions.

For Proposal 1, we are fine for that power saving gain should be justified if SCell dormancy is applied, but there could be some scenarios for WUS separately controlling two DRX groups, e.g. there are 5 SCell groups in each DRX group.

For Proposal 2 4, we found in some materials that DRX configuration can be more adaptive to fit for the traffics, e.g. XR traffic. Maybe, there are still room to enhance the DRX on top of R16/R17 WUS and PDCCH skipping.

For Proposal 6, we are fine the use cases for the serving-cell RRM measurement relaxation should be identified at first. We think the use cases could be for low-speed UEs and stationary UEs, and with development of intelligent network, gNB can identify these UEs and allow them to relax the serving-cell RRM measurement for power efficiency. Relaxing serving-cell RRM measurement could be checked again, since it seems an urgent demand to further reduce power consumption of IoT devices (including RedCap) in idle mode.

**@CATT,**

Thanks for your kindly attentions and questions.

For Proposal 1 4, the reply can be found in our response to MediaTek.

For Proposal 6, it is appreciated that CATT had proposed the low-power receiver in the earlier steps. We share the similar view that we should define the general framework for study, e.g. common understanding of receiver architectures, evaluation methodology.

**@China Telecommunication,**

Thanks for your kindly attentions and questions. We think the green network is our final target. There could be some tradeoff b/w network power saving and UE power saving. Jointly consideration between them is worth to be discussed. In our view, better alignment b/w gNB and UE behaviors can be helpful and more specifications are needed. Some adaptations at UE side could be defined for gNB side, e.g. wakeup and go-to-sleep.

**@Huawei,**

Thank for your kindly attentions and questions.

For uplink-dominant traffic, we are glad to hear that you are also interested in power saving for UL-dominant traffic. For control signaling or data, in our view, most of power saving techniques in R16/R17 are related to control signaling, i.e. PDCCH monitoring adaptation, so control signaling may be the first priority. Reducing the PDCCH monitoring for dynamic grant is our first thought, e.g. PDCCH to scheduling UL traffic in large number of UL CCs. As well, configured grant or SDT are also beneficial for power saving by saving PDCCH monitoring. We are not sure about power saving techniques for data. Maybe concentrating UL transmission in a CC can have power saving gain, when there are large number of UL CCs.

For the low-power radio, we are also glad to hear that you are also interested in investigation of the LP-WUR.

**@Intel,**

Thanks for your kindly attentions and questions. For "dynamic DRX adaptation", in our view, gNB/UE may predict the coming packets "pattern" regarding characteristics of XR, and gNB can change the DRX parameters for the coming packets, e.g. by MAC or DCI. If the DRX parameters change, it may have impact on the properties of onDurationTimer and inactive timer.

**@Xiaomi,**

Thanks for your kindly attentions and questions.

For P1, the response can be found in our reply to MTK.

For P6 1), we share the similar view that the feasibility at both network/UE side should be studied. For P6 2), we think LP-WUR can be used for stationary and low-speed UEs. It can be used for both RedCap and eMBB. Furthermore, it can be specified for NB-IoT/eMTC if the study proves the feasibility and necessity.

**@Apple,**

Thanks for your kindly attentions and questions.

For Q1, regarding P2, please find our thoughts in response to Intel. Regarding P3, we think DRX for the UL-dominant traffic may have room to be enhanced, e.g. active time triggered by SR can be aligned to active time when onDurationTimer or inactivity timer is running.

For Q2, regarding P4, we propose to study separate DL and UL for search space set (leftover of R17) and optimization of PDCCH monitoring for the large number of CCs in CA, e.g. enhancement of SCell dormancy to support more SCell groups.

**@vivo,**

Thanks for your kindly attentions and questions. For overlapping topics for connected mode enhancement, we think some of enhancements could be discussed in the separate topic for UE power saving or in the separate topic of system power saving for both UE and network.

**@Samsung,**

Thanks for your kindly attentions and questions.

For Question 1, we think long eDRX cycle may be the typical scenario, since latency due to long eDRX cycle may be shortened by the "always-on" low-power WUR. The normal DRX/eDRX cycle may be also the scenario, if latency of using the "always-on" low-power WUR is found to be comparable to that of paging reception.

For Question 2, for you mentioned network synchronization, we think there are scenarios for low-speed and stationary UEs to stop the serving cell RRM measurement for a while. The enhancement for mobility could be how gNB/UE know the low-speed and stationary state accurately.

For Question 3, in our view, new requirements for signal/channel DL reception can be specified, but we are not sure whether there are requirements for UL transmission.

@Sony,

Thanks for your kindly attentions and questions.

We agree that there could be different types of architectures. The types of architectures should be studied comprehensively. The types of architectures should be listed at first in the study for aligning companies' understandings.

We are not sure about whether RRM measurement is feasible for the LP-WUR, since RSRP may not be measured by the LP-WUR.

### 2.3.3 <2nd Round> Comments/Questions

The 2<sup>nd</sup> round discussion targets clarifications to answers by moderator in section 2.3.2 and further clarifications on RWS-210064 together. Please share your further questions/comments/views in the following Table 2.3.3.

#### **Feedback Form 5: Table 2.3.3 [Power saving][Second round] Questions/comments/views**

##### **1 – Beijing Xiaomi Mobile Software**

Thanks for the response! Some more comments:

1)Not quite sure of the enhancement on UL-dominant traffic (see response to HW).

How to reduce the PDCCH monitoring to scheduling UL traffic in large number of UL CCs

2)We also think DRX in connected mode enhancement should be studied in XR (see people's proposals for R18 XR) not in UE power saving.

### 2.3.4 <2nd Round> Answers by moderator

@Xiaomi, many thanks for the questions. The corresponding answers/clarifications are provided below.

#### **Answer to Q1:**

For the enhancement on UL-dominant traffic, we think power consumption of monitoring PDCCH for large number of UL CCs can be enhanced. For dynamic grant, one PUSCH should consume one PDCCH, which will cause large number of PDCCH monitoring occasions. In R17 discussion, some enhancements to reduce PDCCH monitoring regarding large number of PDSCH/PUSCH have been proposed or specified, e.g. multi-TB scheduling, multi-user scheduling, multi-slot scheduling. We think these enhancements can be considered for UL traffic in large number of UL CCs. On the other hand, enhancement of SCell dormancy to support more SCell groups can be considered (see our response to Apple in the first round).

#### **Answer to Q2:**

Some companies, e.g. MTK and QC, have mentioned to consider the power saving at both gNB and UE side, namely system power saving. We also think the enhancements for UE power saving in R18 can be considered in the system power saving.

## 2.4 NR positioning enhancements

### 2.4.1 <1st Round> Comments

In the contribution RWS-210065, we share some considerations on Rel-18 Positioning with the following observations and proposals:

**Observation 1: Study on sidelink positioning in RAN plenary will be finished by the end of RAN#93.**

**Observation 2: AI-based positioning can be discussed separately, i.e. in AI related study item.**

**Proposal 1** □ **Study potential techniques to enable sidelink positioning**

- **Define evaluation scenarios for the UE in in-coverage, partial coverage, and out-of-coverage**

- **Study potential solutions of sidelink positioning**

- **Study positioning architecture for sidelink positioning**

**Proposal 2: NR positioning should be further enhanced to achieve low power consumption in Rel-18.**

Regarding the above proposals for R18 Positioning and RWS-210065, the Table 2.4.1 is to collect questions/comments from companies.

**Feedback Form 6: Table 2.4.1 [Positioning] Questions/comments**

#### 1 – CATT

For AI-based positioning, in CATT's view it might be better to be included in positioning SI/WI with the following considerations:

- 1) AI/ML models/algorithms are highly application specific. For example, the AI/ML models/algorithms for MIMO or channel estimation may not be suitable for positioning;
- 2) Some companies have presented the results of using AI/ML techniques for improving NR positioning performance in Rel-17 ePOS WI.

#### 2 – Beijing Xiaomi Mobile Software

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Q1: Do you think the commercial and public safety use cases and requirements identified in SA1 Ranging WI(TR22.855/TS22.261) should be taken into account?

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Q2: According to the definition and the KPI requirements of relative positioning and ranging in TS22.261(see below), do you agree that relative positioning and ranging are different, i.e. relative positioning requires to acquire the 2D/3D coordinates(e.g. the horizontal accuracy of relative positioning set requirements on both distance accuracy and angle accuracy) while Ranging requires to acquire only one component of 2D/3D coordinates(either distance or angle) and thereby only set requirements on one component(either distance or angle)?

<ul style="list-style-type: none"> <li>○ Relative positioning: relative positioning is to estimate position relatively to other network elements or relatively to other UEs.</li> </ul>
<ul style="list-style-type: none"> <li>○ Ranging: refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct communication connection.</li> </ul>
<p>-</p> <p>Q3: Do you think unlicensed band should be considered? If so, what frequency range is considered (e.g. 60GHz)?</p>
<p><b>3 – Nokia France</b></p> <p>Do you see "low-power positioning" as being targeted at RedCap devices?</p>

#### 2.4.2 <1st Round> Answers by moderator

Thanks to **CATT/Xiaomi/Nokia** for your valuable questions and comments on R18 positioning topic. Our answers to these questions are provided below:

**@CATT,**

Thanks for sharing your considerations. Glad to see that we have the same view that AI/ML based positioning should be studied in Rel-18. Regarding AI based positioning included in which item: AI related item or positioning item, we prefer the former. This is the first time to discuss AI in PHY in 3GPP. Some common understanding on terminology, the data set construction, evaluation methodology, and so on for all use cases in PHY should be achieved at first, then study and specification can be carried out case by case. Although we have different preference on how to handle AI/ML based positioning, we believe this is not critical and can be discussed and decided later.

**@Xiaomi,**

For Q1: We are open to discuss how to support ranging service based on positioning procedure.

For Q2: Yes. We share your view and agree that the definition and the KPI requirements of relative positioning and ranging are different. Ranging use cases are not needed to convert measurement results to relative location coordinates of one UE from the other one. This may only influence the granularity of measurement metrics, positioning measurement and calculation procedure, and so on. Even so, we think that relative positioning and ranging can be unified into one RAN SI/WI for discussion.

For Q3: For unlicensed band of positioning, we think large bandwidth and abundant spectrum resources in unlicensed band are very helpful to improve positioning accuracy. However, due to possible limited TU, we think the priority of unlicensed band positioning may be lower than other positioning enhancements.

**@Nokia,**

We think low power is a common positioning requirement. It could be for Redcap UEs, and also could be for other UEs, e.g. InF devices.

### 2.4.3 <2nd Round> Comments/Questions

The 2<sup>nd</sup> round discussion targets clarifications to answers by moderator in section 2.4.2 and further clarifications on RWS-210065 together. Please share your further questions/comments/views in the following Table 2.4.3.

#### **Feedback Form 7: Table 2.4.3 [Positioning][Second round] Questions/comments/views**

##### **1 – LG Electronics Inc.**

Q1: Regarding AI based positioning, you think that AI is used for Los/N-Los identification by providing N-Los information as you mentioned in your contribution (RWS-210063). Could you let us know which information is needed for example? In addition, could you explain more details such as how to use it for AI?

### 2.4.4 <2nd Round> Answers by moderator

@LG, many thanks for your question. In our views, AI-based LOS/NLOS identification can be implemented by gNB. gNB can acquire the estimated channel by measuring UL SRS, and use it as the input parameter of AI model.

## 2.5 NR MBS enhancement

### 2.5.1 <1st Round> Comments

In the contribution RWS-210066, we share some considerations on Rel-18 NR MBS with the following proposals.

***Proposal 1: Objective B should be included in R18 WID and FTA should be supported to enable Objective B. (RAN2)***

***Proposal 2: Intra-CU SFN should be studied. (RAN2)***

***Proposal 3: Further enhancement for multiplexing of MBS and Unicast services (HARQ/CSI/SR)with different priorities should be studied (Based on Rel-17 discussion progress).(RAN1)***

***Proposal 4: MBS is supported for SN in MR-DC. (RAN2)***

***Proposal 5: Inter-RAT handover should be studied. (RAN2)***

***Proposal 6: For IDLE/INACTIVE UEs, multicast service reception and performance enhancement are supported. (RAN2, RAN1)***

Regarding the above proposals for R18 NR MBS and RWS-210066, the Table 2.5.1 is to collect questions/comments from companies.

**Feedback Form 8: Table 2.5.1 [NR MBS] Questions/comments**

**1 – HUAWEI TECHNOLOGIES Co. Ltd.**

[Huawei, HiSilicon] Q1: on inter-RAT HO and service continuity, is the assumption that NR MBS can also be received in E-UTRAN?

**2 – BBC**

BBC supports the evolution of NR MBS under Rel-18.

In particular to the specific topics listed in your contribution, we think the following topic has higher priority:

- receive only mode to support FTA;

Note that BBC has also proposed the topics above for Rel-18 in RWS-210133 and being discussed under [RAN-R18-WS-crossFunc-BBC] in NWM.

Questions:

We have the following questions comments from the following topics listed in your contribution:

- Proposal 2: Intra CU SFN should be studied
  - o Are you considering changes in sub-carrier spacing and/or CP?

- We have concerns that significant changes in UEs may hinder the deployment of the feature. As stated in our contribution [RWS-210133] and being discussed under [RAN-R18-WS-crossFunc-BBC] in NWM we believe widespread feature support in handsets is essential. Specially for UEs in RRC\_IDLE/INACTIVE that may not be able to signal back to the gNB the capability, enhancements that force significant changes in the UEs may limit the reach of Multicast and Broadcast.

- Considerations should be taken in whether simulcasting two signals (with different CPs) would be overall beneficial to the system spectral efficiency.

- Another aspect to consider is whether the reference signals frequency sampling (assuming are unchanged) can cope with the additional channel selectivity from deployments with larger ISDs and therefore extended CPs.

**3 – Qualcomm Incorporated**

On P1: 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 in Proposal 1?

On P2: Rel-17 already supports intra-DU SFN. In our view, intra-CU SFN adds more complexity and does not improve efficiency in dense deployments.

On P6: 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.

#### 4 – Intel Corporation (UK) Ltd

- 1) Regarding service continuity for inter-RAT HO, what is the assumption for the core network for LTE and NR?
- 2) For multicast reception in RRC\_IDLE, since SA2 only agrees the support of multicast in CM-CONNECTED and RRC\_IDLE corresponds to CM\_IDLE state, how to resolve the conflicts with SA2 conclusion?
- 3) Is the proposal for SPS and PDSCH repetition for RRC\_IDLE/INACTIVE for multicast only?

#### 5 – MediaTek Inc.

Thanks for the proposal. Can you clarify the scenario for Inter-RAT handover for MBS?

#### 6 – CATT

Thank you for the contribution.

A general comment is that CATT supports NR MBS enh. in Rel-18.

Then one question for clarification:

By 'inter rat HO', do you mean HO btw 5G MBS and LTE eMBMS? Would this impact also CN?

#### 7 – ZTE Corporation

Thanks for the contribution. Below are our questions:

-

Regarding the MBSFN, do you see the need to support different numerology (e.g., different SCS or CP) for MBSFN and unicast? If yes, then how to support simultaneous reception of MBSFN and unicast?

-

If SPS in INACTIVE is supported, how to guarantee the reliability/QoS, e.g., via HARQ?

-

Can the need for Objective B and large area broadcast (e.g., cross DU) already be met by Rel-16?

-

Considering the real deployment of LTE eMBMS, is the market need clear for inter-RAT HO?

### 2.5.2 <1st Round> Answers by moderator

Many thanks to **HW/BBC/QC/MTK/Intel/CATT/ZTE** for your valuable questions and comments on R18 MBS topic. The answers by moderator are listed below:

- 1) For the inter-RAT HO related issues asked by **HW, MTK, Intel, CATT and ZTE**, we consider inter-RAT

HO shall be divided into 2 types:

-Type 1: E-UTRAN and NG-RAN have individual CN, EPC and 5GC.

-Type 2: E-UTRAN and NG-RAN share a common CN, e.g., 5GC.

In our opinion, Type 1 can be studied at the first step.

As a prerequisite, NR MBS can only be provided in NG-RAN and LTE eMBMS can only be provided in E-UTRAN. Inter-RAT HO for MBS should be supported for the service continuity during mobility.

Inter-RAT HO in our proposal means HO between 5G (MBS node or non-MBS node) and LTE (eMBMS-node or non-eMBMS node). The basic scenario is the inter-RAT HO with the multicast/unicast switching. It will impact CN to some certain degree. CN has already supported the interworking with MBMS over E-UTRAN for public safety services [TS 23.247 6.8]. For the inter-RAT HO without multicast/unicast switching, it should be low priority. More support of CN may be needed and can be further studied.

History has given us experience and could be learned. On the basis of LTE, we have enhanced NR MBS to improve the deployment flexibility. We think inter-RAT HO should be specified for service continuity and then meet market demand, e.g., from NR to LTE area where the LTE eMBMS is not deployed.

2) For the intra-CU SFN related issues asked by **BBC, ZTE and QC**, we think intra-DU SFN is not enough for large area broadcast, e.g., at least in rural area, and intra-CU SFN can improve efficiency. In general, we are open to all possible solutions for the intra-CU SFN. However, we also think it is important to avoid introducing high complexity requirement for UE.

3) For the multicast reception in RRC\_IDLE related issue asked by **QC and Intel**, we think IDLE UE should not be excluded. According to SA2 agreement, upon multicast session deactivation, UE can be released to CM\_IDLE. When multicast session is activated, CM\_IDLE UE will be notified. It means that the MBS session context should be stored in CM\_IDLE UEs. From RAN point of view, the MBS data reception in INACTIVE UE and IDLE UE is very similar, it is easy to support multicast in RRC\_IDLE. If some changes are needed in SA2, RAN2 can send LS to SA2 when the requirement is confirmed. Anyway, we can make further study.

4) For the FTA asked by **QC**, yes, we mean ROM, and we propose to study the impact on RAN. For question from **ZTE**, We think objective B is supported in LTE eMBMS. However, it is not supported in NR R17 due to limited time budget. We think it should be supported in NR R18.

5) For SPS question from **Intel**, we think the SPS and PDSCH repetition for RRC\_IDLE/INACTIVE can be applicable for both multicast and broadcast.

6) For question from **ZTE**: *If SPS in INACTIVE is supported, how to guarantee the reliability/QoS, e.g., via HARQ?*, in our opinion, the conservative scheduling can be applied to guarantee the reliability. For example, using relatively lower MCS, lower code rate and bind repetition is to improve the performance of cell edge UE while sacrificing some efficiency as a price. Moreover, introducing HARQ-ACK feedback is also a possible solution.

### 2.5.3 <2nd Round> Comments/Questions

The 2<sup>nd</sup> round discussion targets clarifications to answers by moderator in section 2.5.2 and further clarifications on RWS-210066 together. Please share your further questions/comments/views in the following Table 2.5.3.

**Feedback Form 9: Table 2.5.3 [NR MBS][Second round] Questions/comments/views**

**1 – BBC**

Thank you for your responses. Given the range of views on SFN first a consensus view should be formed on whether or not take this work further. A pragmatic next step may be to study whether there is any benefit in enhancing SFN, and to assess any requirements for changes to SCS/CP and any corresponding implications for UEs etc.

**2 – ZTE Corporation**

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

- on inter-RAT HO, there is hardly any LTE eMBMS deployment, therefore we generally don't think it is necessary to have extra study of such inter-RAT HO in NR; and if there is a need for standardization, this alternatively can be initiated from SA1 (requirement) or evaluated from SA2 first (architectural perspective)?
- on SFN, if cross gNB or DU SFN is to be supported, we tend to think this could be done intra PLMN and implementation based.
- on the objective B: If Rel-16 can do the job (related RAN4 work is still in progress), maybe we don't need a replication is needed so soon in NR?
- on RRC\_IDLE/INACTIVE. Based on the 1st round of Q&A, it seems Spreadtrum is also interested in IDLE/INACTIVE enhancement for MBS. Without any enhancement, network has to use conservative MCS to schedule MBS, which may end up with low system efficiency. Do you see any potential necessity to increase the throughput/spectrum efficiency for MBS transmission in IDLE/INACTIVE?

**3 – HUAWEI TECHNOLOGIES Co. Ltd.**

[Huawei, HiSilicon] On Inter-RAT HO, thanks for explanations. If we are discussing handover from NR multi-cast to LTE unicast, it seems more a SA related issue.

2.5.4 <2nd Round> Answers by moderator

Many thanks to **BBC/ZTE/Huawei** for your valuable questions and comments on R18 MBS topic. The answers by moderator are listed below:

**@BBC,**

Thanks for your questions. Yes, we have similar views.

**@ZTE,**

Thanks for your questions.

**Answer to Q1:** The inter-RAT HO can be used for future even if there is hardly any LTE eMBMS deployment currently. The multicast to unicast inter-RAT HO should be supported at least. SA2 are studying the inter-system mobility now.

**Answer to Q2:** We agree the intra PLMN scenario is simple and should be studied first.

**Answer to Q3:** The object B was already agreed in R17 SA2 SI and it was not completed due to limited time

**Answer to Q4:** Our intention is to maintain the reliability of MBS for IDLE UEs. In our view throughput/SE enhancement is more suitable for RRC-connected UEs, but at the current stage we are open for this issue, necessity and more details can be discussed in future.

@Huawei,

Thanks for your questions.

Yes, it is SA related. But the RAN related part needs to be studied in RAN, e.g. the lossless, RRC configuration in target node.

## 2.6 IIOT/URLLC enhancements

### 2.6.1 <1st Round> Comments

In the contribution RWS-210067, we share some considerations on IIOT/URLLC with the following observations and proposals.

***Observation 1: For specific IIoT/URLLC enhancements in Re-18, they are highly correlated with new scenarios, such as XR applications, factory automation and power distribution automation for specific high reliability requirement.***

***Proposal 1: Regarding the leftover of IIoT/URLLC enhancement: the multi-TRP related enhancement can be discussed in R18 eMIMO item; and the other part can be specified in R18 TEI.***

***Proposal 2: For specific IIoT/URLLC enhancements in Re-18, it is better to study case by case in its related item under the same scenario. FFS whether to have one jointed IIoT/URLLC item.***

Regarding the above proposals for R18 IIOT/URLLC and RWS-210067, the Table 2.6.1 is to collect questions/comments from companies.

#### **Feedback Form 10: Table 2.6.1 [IIOT/URLLC] Questions/- comments**

##### **1 – Nokia Germany**

On proposal 1, the 'other part' seem to refer to the CSI enhancement topic in R17 IIoT WI which had been quite controversial so far. Do you think it is feasible to have it as part of R18 TEI (which usually should be rather small & non-controversial)?

##### **2 – Apple Italia S.R.L.**

For proposal 1, we also think any leftover IIoT/URLLC enhancements with multi-TRP should be discussed in R18 MIMO item. However, we wonder what other leftover items are being considered by Spreadtrum. Typically any IIoT/URLLC enhancements can be too complicated to fit in TEI.

For proposal 2, we agree that each enhancement should be considered case-by-case. For example, it is better to consider XR-related enhancements in the XR WI.

## 2.6.2 <1st Round> Answers by moderator

Many thanks to **Nokia/Apple** for your valuable questions and comments. Our answers to these questions are provided below:

**@Nokia and Apple,**

The downscoping of Rel-17 URLLC/IOT has been discussed in RAN #92-e meeting. It has been agreed to focus CSI feedback enhancement on subband-CQI and delta-MCS, and do no further discussion of SPS HARQ-ACK skipping and size reduction in HARQ-ACK enhancement in Rel-17. For the leftover: SPS HARQ-ACK skipping and size reduction, the observation on TEI part from Nokia and Apple are correct. Considering the large workload, SPS HARQ-ACK skipping and size reduction is more suitable to put into Rel-18 XR item or other items. For some other Rel-17 leftover issues if there exist and necessary, we are open to consider them case-by-case into different items, or put them into TEI discussion or set an independent Rel-18 URLLC/IOT item. Thanks.

## 2.6.3 <2nd Round> Comments/Questions

The 2<sup>nd</sup> round discussion targets clarifications to answers by moderator in section 2.6.2 and further clarifications on RWS-210067 together. Please share your further questions/comments/views in the following Table 2.6.3.

### **Feedback Form 11: Table 2.6.3 [IIOT/URLLC][Second round] Questions/comments/views**

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## 2.6.4 <2nd Round> Answers by moderator

No questions/comments from 2<sup>nd</sup> Round.

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# 3 Reference

- [1] RWS-210002, Some details for RAN Rel-18 Workshop, RAN Chair
- [2] RWS-210063, Consideration on R18 AI/ML enabled RAN enhancement, Spreadtrum Communications
- [3] RWS-210064, UE power saving enhancements for R18, Spreadtrum Communications
- [4] RWS-210065, NR positioning enhancements for R18, Spreadtrum Communications
- [5] RWS-210066, MBS enhancements for R18, Spreadtrum Communications
- [6] RWS-210067, IIoT/URLLC enhancements for R18, Spreadtrum Communications