RAN-R18-WS-crossFunc-MediaTek - Version 0.0.4
RAN

3GPP TSG RAN Rel-18 Workshop, June 28th-July 2nd, 2021

TDoc: RWS-210631

Source: **MediaTek Inc**

Title: **Summary of email discussion RAN-R18-WS-crossFunc-MediaTek**

Document for: **Endorsement**

Agenda Item: **4.3**

Work Item / Release: **Rel-18**

Abstract: This contribution provides a summary of the email discussion on RAN-R18-WS-crossFunc-MediaTek

1 Introduction

This document collects Q&A corresponding to contributions listed below.

NOTE: The ”crossFunc” classification was self-assigned by the author.

Table 1:

Agenda Item	TDoc	Title	Source
4.3	RWS-210098	[x-area] Sidelink Relay Enhancements	MediaTek Inc.
4.3	RWS-210099	[x-area] Smart Repeaters Enhancements	MediaTek Inc.
4.3	RWS-210102	[x-area] NTN/TN Spectrum Sharing	MediaTek Inc.
4.3	RWS-210103	[x-area] AI/ML Integration	MediaTek Inc.
4.3	RWS-210104	[x-area] AI/ML Traffic	MediaTek Inc.
4.3	RWS-210105 updated to RWS-210652	[x-area] Mobility Enhancements	MediaTek Inc.
4.3	RWS-210106	[x-area] System Energy Enhancements	MediaTek Inc.

4.3	RWS-210107	[x-area] Positioning Enhancements	MediaTek Inc.
4.3	RWS-210197	[x-area] Sub-band Full-duplex for gNB	MediaTek Inc.

Each of these contributions includes a motivation and a set of proposed objectives. This email discussion intends to clarify via Q&A the motivation and individual objectives for each of these contributions. It is structured as follows:

- Section 2.1 contains Q&A tables for RWS-210098 for the motivation and each individual objective
- Section 2.2 contains Q&A tables for RWS-210099 for the motivation and each individual objective
- Section 2.3 contains Q&A tables for RWS-210102 for the motivation and each individual objective
- Section 2.4 contains Q&A tables for RWS-210103 for the motivation and each individual objective
- Section 2.5 contains Q&A tables for RWS-210104 for the motivation and each individual objective
- Section 2.6 contains Q&A tables for RWS-210105 for the motivation and each individual objective - updated to RWS-210652 for 2nd round
- Section 2.7 contains Q&A tables for RWS-210106 for the motivation and each individual objective
- Section 2.8 contains Q&A tables for RWS-210107 for the motivation and each individual objective
- Section 2.9 contains Q&A tables for RWS-210197 for the motivation and each individual objective
- Section 3 provides a summary

2 Email Discussion

2.1 RWS-210098 – Sidelink Relay Enhancements

2.1.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- To ensure service coverage & availability where service is to be consumed.

- To enable new service consumption models with optimal routing e.g. local gaming, local data exchange.
- To improve reliability.
- To support full mobility.

Feedback Form 1: Questions

1 – CATT Thanks for the contribution. We generally agree that relay work should continue in Rel-18, as stated in our paper RWS-210407.
2 – HuaWei Technologies Co. 1. We have similiar understanding on having multi-path support, and in our understanding for UL this mainly requires the gNB to aggregate the data from multi-path (including direct and indirect path), is it consistent with your proposal? 2. In Rel-17 we have not yet supported U2U and we think it may be possible to have a fundamental U2U function for Rel-18, and do you think we can start from single hop on U2U?
3 – InterDigital At what protocol layer do you expect network coding to be studied/implemented?
4 – Nokia Denmark question: UE scheduling other UE should be independent with UE2UE relay as general feature if 3GPP wants to specify it? Question: what is found mentation difference of ”mobile relay” with UE2UE or UE2NW relay? Why should it be considered separately?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 2:

Questions	**Answers**
1 – CATT	Thank you.
2 – HuaWei Technologies Co. We have similiar understanding on having multi-path support, and in our understanding for UL this mainly requires the gNB to aggregate the data from multi-path (including direct and indirect path), is it consistent with your proposal? In Rel-17 we have not yet supported U2U and we think it may be possible to have a fundamental U2Ufunction for Rel-18, and do you think we can start from single hop on U2U?	In UL direction, we understand the gNB should aggregate the data from multiple paths. We think the goal should be to have multihop and multi-path for both U2N and U2U. Our preference would be to define a common multihop approach for both cases rather than having only single-hop for U2U.

3 – InterDigital At what protocol layer do you expect network coding to be studied/implemented?	We tend to think it could be done as part of the adaptation layer functionality, so that coding is at the level of PDCP PDUs.
4 – Nokia Denmark question: UE scheduling other UE should be independent with UE2UE relay as general feature if 3GPP wants to specify it? Question: what is found mentation difference of ”mobile relay” with UE2UE or UE2NW relay? Why should it be considered separately?	For the UE-scheduling-UE approach, we see it as important to have for the relaying case so the relay can schedule its remote UEs, but we would be open to considering it as a general sidelink enhancement. For U2U relay, “mobility” seems only applicable to the case that the remote UE changes relay UEs (path switch from one relay UE to another relay UE), which would be included under objective 2 below. For U2N relay, there is also the “mobile relay” case in which the relay UE changes serving cell while keeping its remote UEs (group mobility). We’ve considered these as separate objectives since they can be specified independently.

Please provide Round 2 questions below.

Feedback Form 2: Round 2 questions

1 – HuaWei Technologies Co.

Thank you for sharing your view. We undetstand the intention for a common solutin for multi-hop U2U and U2N relay. However, our concern is that we may have different design/apporach for U2U and U2N relay and may require more standard efforts for them to converge.

In Rel-17, RAN2 discussed the Relay selection for L2 U2N relay and it was concluded that it is remote UE (i.e., the UE searching a cell/gNB) to select the relay UE if remote UE is in IDLE/INACTIVE. While, for CONNECTED remote UE, it is up to gNB implementation.

For U2U relay, SA2 studied the relay (re)selection mechanisms and captured them as Solution#8 and Solution#50 in TR 23.752. We can find that in both Solution#8 and Solution#50, it is the target UE (instead of the UE searching a peer UE) to make the final decision on the relay selection. It is quite different from what is defined for L2 U2N relay. So we are wondering whether it is possible to have a common design?

2 – Philips International B.V.

We fully agree with your main motivation for the Sidelink Relay enhancements i.e. ensuring service coverage and availability.

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?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 3:

Questions	**Answers**
1 – HuaWei Technologies Co. (regarding U2N and U2U relay)	This is a good point that there may be differences between the U2U and U2N designs in some aspects like (re)selection, and we agree that the designs will not be identical. However, in terms of integrating multi-hop into the relaying architecture, we anticipate that the impact on e.g. routing in the adaptation layer should be the same. So we have to do some work to specify a U2U relay architecture (objective 1), but when we have single-hop U2U and multihop U2N, we understand that much of the work for multihop U2U will be done.
2 – Philips International B.V. (regarding LTE-M, NB-IoT, and RedCap with sidelink relay)	While we see the appeal of implementing the relay architecture for E-UTRA, this would take a significant amount of additional work (basically recapitulating the Rel-17 WI), and we are more focussed at this stage on progressing the relaying feature for NR. In the case of RedCap, we expect the features could be independent: A RedCap UE (that supports sidelink) should be able to benefit from relaying like any other remote UE.

2.1.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: Rel-17 left-overs [RAN1, 2, 4]

- L2 UE-to-UE Relay
- UE scheduling other UE

NOTE: no relay-specific impact anticipated for supporting unlicensed spectrum (see SL enhancements in RWS-210097)

Feedback Form 3: Questions

1 – Lenovo (Beijing) Ltd Agree to have U2U in Rel-18. For UE scheduling other UE, is the scheduler a relay? My understanding is that non-relay UE also can schedule other UE.
2 – Qualcomm Incorporated Regarding UE scheduling another UE in the Relay case, which option (discussed in Rel-17 SL enhancement) is assumed to be used?
3 – CATT For U2U relay, it seems here the focus is L2 arch.. But is it so that this needs further discussions and it may involve both RAN and SA? So maybe we could remain a bit open at this stage?
4 – CATT Then for UE scheduling other UE, this has been discussed during R17 enh. So maybe this could be further discussed here and there in that topic.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 4:

Questions	**Answers**
1 – Lenovo (Beijing) Ltd Agree to have U2U in Rel-18. For UE scheduling other UE, is the scheduler a relay? My understanding is that non-relay UE also can schedule other UE.	We agree that this could be considered as a general sidelink enhancement, depending on how the relevant WIs are structured.
2 – Qualcomm Incorporated Regarding UE scheduling another UE in the Relay case, which option (discussed in Rel-17 SL enhancement) is assumed to be used?	We see this as a version of the option that the preferred resources indicated by the Rx UE are used for the Tx UE's transmission.
3 – CATT For U2U relay, it seems here the focus is L2 arch.. But is it so that this needs further discussions and it may involve both RAN and SA? So maybe we could remain a bit open at this stage?	Our understanding is that L3 U2U relay was determined not to have RAN impact. Moreover, we don't see that the L3 U2U relay is viable for many use cases as there is no way to do end-to-end security. So we've focussed on the L2 case.
4 – CATT Then for UE scheduling other UE, this has been discussed during R17 enh. So maybe this could be further discussed here and there in that topic.	See above—we are open to consider this as a general SL enhancement, depending on how the group want to structure SL-related WIs.

Please provide Round 2 questions below.

Feedback Form 4: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.1.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: Topology Enhancements [RAN2, 4]

- Support for multi-hop
- Support for multi-path (incl. PC5+PC5 and PC5+Uu)
- Mobility of Remote UE between Relay UEs

Feedback Form 5: Questions

1 – CATT 1) For multipath, could you clarify whether it is mainly for reliability improvement? If so, does that mean it is the same service that goes through different paths? 2) In the intended scope, do UE support simutaneous tx/rx in the different paths? 3) in this bullet, only R2/4 listed, would there be any work in R1?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 5:

Questions	**Answers**

1 – CATT 1) For multipath, could you clarify whether it is mainly for reliability improvement? If so, does that mean it is the same service that goes through different paths? 2) In the intended scope, do UE support simutaneous tx/rx in the different paths? 3) in this bullet, only R2/4 listed, would there be any work in R1?	1. For multi-path, we consider it mainly for reliability improvement, so a single service could go through multiple paths. 2. This question depends on the definition of "simultaneous". The UE would need to support transmission/reception on both paths while operating the service, but we could discuss if this requires truly simultaneous communication or if the different paths can be time-multiplexed for the UE. 3. Possible RAN1 impact is a fair point and could depend partly on point 2. E.g., if there is a need for the UE to do power splitting between two paths, it would affect RAN1.

Please provide Round 2 questions below.

Feedback Form 6: Round 2 questions

1 – CATT

Many thanks for the round 1 discussions. Seems our view aligned well.

Then multipath relay, we'd like to further clairfy on the bullets. More specifically do you consider multi hop + multi path, because in our understanding that might be quite complex and seems not very argent to consider.

Then for the sake of complexity, maybe could further clarify whether for multipath (PC5+Uu), dual connectivity in Uu is considered.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 6:

Questions	**Answers**

1 – CATT (regarding multihop+multi-path and Uu dual connectivity)	We think the complexity of multihop+multi-path depends somewhat on how the multihop routing is designed. Considering it from the viewpoint of the Tx UE, supporting multiple paths requires transmitting the packet on each path; this should be possible to do with separate multihop routes to the Rx UE, just as it would be possible to do with separate single-hop relays to the Rx UE. The subsequent hops in each path just deliver the packet according to the rest of the route, without needing to know anything about the other paths. So we don't see that there needs to be a lot of interaction between these two features. We could also take some inspiration from the discussions that already took place in IAB for similar routing problems. For the combination of Uu DC and Uu+PC5 multi-path, we interpret that this is about a remote UE in DC with Uu and also receiving data via a relay under the MN, so that with a suitable bearer configuration it could receive/transmit a packet via three paths: Uu with the SN, Uu with the MN, and PC5 with the relay UE under the MN. The modelling of multi-path could already look like DC (with the relay UE in the role of the SN), so adding a third path may just extend the model to multi-connectivity. In principle this seems tenable at least for an MN-terminated split bearer, but we aren't sure that it is a crucial use case.

2.1.4 Objective 3

Companies are kindly invited to provide their questions to the following objective:

Objective: Mobile Sidelink Relays e.g. vehicle-mounted relays [RAN2, 3]

- Group handover of Remote UEs with U2N Relay UE
- "Resume in different cell" case for Relay UE in RRC_INACTIVE

Feedback Form 7: Questions

1 – Lenovo (Beijing) Ltd

If vehicle-mounted relays is considered, to distinguish the inside-UE and outside-UE could be helpful for gNB to determine which UE can be involved in group-based mobility.

2 – CATT

Regarding the part 'Resume in different cell', could you clarify whether this is already not possible with R17 mechanism?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 7:

Questions	**Answers**
1 – Lenovo (Beijing) Ltd If vehicle-mounted relays is considered, to distinguish the inside-UE and outside-UE could be helpful for gNB to determine which UE can be involved in group-based mobility.	We don't immediately see how this would be reflected in the spec. Once we have a mechanism for group mobility, it seems to be applicable regardless of inside/outside status. But OK to discuss if something like this is helpful for the network.
2 – CATT Regarding the part 'Resume in different cell', could you clarify whether this is already not possible with R17 mechanism?	If the relay UE resumes from RRC_INACTIVE in a different cell, the context retrieval needs to take place for the remote UEs as well as the relay UE. In the Rel-17 mechanism, the legacy resume procedure is available, but there is no specific tasking for WGs to enable this "group resume", so we anticipate that something is needed in Rel-18.

Please provide Round 2 questions below.

Feedback Form 8: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.1.5 Objective 4

Companies are kindly invited to provide their questions to the following objective:

Objective: Network Coding Transmission by Relay UE [RAN2, 4]

NOTE: Relevance esp. for multi-hop/multi-path

Feedback Form 9: Questions

1 – Qualcomm Incorporated At which level is network coding applied?
2 – CATT This is intersting area to discuss. Could you clarify what is this network coding specific to SL, e.g., could it be used for Uu as well?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 8:

Questions	Answers
1 – Qualcomm Incorporated At which level is network coding applied?	We tend to think it could be done as part of the adaptation layer functionality, so that coding is at the level of PDCP PDUs.
2 – CATT This is intersting area to discuss. Could you clarify what is this network coding specific to SL, e.g., could it be used for Uu as well?	The premise of the network coding proposal is that we have a network with multiple paths from source to destination. This could also occur in Uu situations, so in principle it seems possible to apply similar ideas there, but our focus has been on the applicability to sidelink.

Please provide Round 2 questions below.

Feedback Form 10: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.2 RWS-210099 – Smart Repeaters Enhancements

2.2.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- To ensure service coverage & availability where service is to be consumed.
- To limit additional interference via Tx power control at the repeater (i.e. Repeater to gNB/UE).

- Backwards compatibility with legacy NR UEs.

Feedback Form 11: Questions

1 – CATT

Thanks for the contribution and we have following questions for clarification:

Q1: How does the gNB/repeater get the information of Tx/Rx beam between repeater and UE?

Q2: Does the repeater have to send some reference signal of its own?

Q3: What is expected to be done to support beamforming? What is the exact scope of Objective I?

Q4: Is repeater transparent to UE or not?

Q5: How to control the interference to other co-channel devices? Does the other co-channel devices need to perform some sort of measurement with respect to the repeater?

2 – KDDI Corporation

Thank you very much for your proposals. We are also interested in smart repeater, as mentioned in our contribution (RWS-210300). In order to understand your proposal more concretely, let us ask you a few questions below.

<Q1>

Are you assuming that the smart repeater does not move, i.e. it is fixed? If it does not move, we imagine that the beam of the smart repeater toward the gNB is somewhat fixed, and only the beam to the UE is adaptively controlled.

<Q2>

In Slide 4, the uplink Tx power control mechanism from the repeater to the gNB is also included in the objective. Does this mean that the gNB performs Tx power control of the UE uplink and also performs Tx power control of the repeater uplink at the same time?

3 – Sony Corporation

Thank you for your proposals on smart repeaters. Here are some questions from us:

1. In slide 4, could you please elaborate a bit on the enhancements to CSI-RS beam for PDCCH/PDSCH and SRS beam for PUCCH/PUSCH that you think are required to enable smart repeaters?

2. In slide 5, do you foresee required enhancements to obtain the power control or ON/OFF information needed to mitigate co-channel interference?

4 – Intel Corporation (UK) Ltd

1) Further clarifications on ”Objective 1: Support for beamforming” are encouraged. Does it mean Repeater transmission of SSB, SI, … to the UEs or something else?
2) What kind of L1/L2/L3 capabilities are needed at the Repeater side? Given the support of selected L1-L2 functionality, what are the cost advantages over IAB?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 9:

Questions	**Answers**
1 – CATT Thanks for the contribution and we have following questions for clarification: Q1: How does the gNB/repeater get the information of Tx/Rx beam between repeater and UE? Q2: Does the repeater have to send some reference signal of its own? Q3: What is expected to be done to support beamforming? What is the exact scope of Objective I? Q4: Is repeater transparent to UE or not? Q5: How to control the interference to other co-channel devices? Does the other co-channel devices need to perform some sort of measurement with respect to the repeater?	Thanks for your questions. A1: Our principle is to keep repeater transparent to UE. Based on this principle, our initial thinking is to reuse legacy CSI framework as much as possible to perform beam management between repeater and UE. For example, given a fixed beam between gNB and repeater, repeater may sweep multiple beam directions so that the UE gets multiple L1-RSRP measurements for each direction. Repeated resources are needed in the gNB-repeater link. The UE is not aware of that the multiple transmission beam directions are due to gNB or repeater. A2: In most cases we think no. However for pathloss measurement facilitating power control, sending its own RS or the repeater still amplifies and forwards its received RS can be both considered. We are open to investigate all possible solutions. A3: Our expectation is to have complete solutions to support beam management and beam switch between repeater and UE, for both DL and UL, like what we've had for the link between gNB and UE. The solutions may have no or minor spec impact. A4: Our principle is to keep repeater transparent to UE. A5: The answer depends on how smart the repeater will be. Controlling ON/OFF state of a repeater may be the baseline without need more measurement w.r.t. a repeater. To further control repeater's Tx power, some RS measurement with respect to the repeater is needed (as stated in A2) to allow gNB to control Tx power accordingly.

2 – KDDI Corporation Thank you very much for your proposals. We are also interested in smart repeater, as mentioned in our contribution (RWS-210300). In order to understand your proposal more concretely, let us ask you a few questions below. <Q1> Are you assuming that the smart repeater does not move, i.e. it is fixed? If it does not move, we imagine that the beam of the smart repeater toward the gNB is somewhat fixed, and only the beam to the UE is adaptively controlled. <Q2> In Slide 4, the uplink Tx power control mechanism from the repeater to the gNB is also included in the objective. Does this mean that the gNB performs Tx power control of the UE uplink and also performs Tx power control of the repeater uplink at the same time?	Thanks for your questions. A1: Yes we assume repeater is fixed. We agree only the beam to the UE needs to be adaptively controlled. A2: Yes we expect gNB can control repeater's Tx-power.
3 – Sony Corporation Thank you for your proposals on smart repeaters. Here are some questions from us: 1. In slide 4, could you please elaborate a bit on the enhancements to CSI-RS beam for PDCCH/PDSCH and SRS beam for PUCCH/PUSCH that you think are required to enable smart repeaters? 2. In slide 5, do you foresee required enhancements to obtain the power control or ON/OFF information needed to mitigate co-channel interference?	Thanks for your questions. A1: Our principle is to keep repeater transparent to UE. Based on this principle, our initial thinking is to reuse legacy CSI framework as much as possible to perform beam management between repeater and UE. For example, given a fixed beam between gNB and repeater, repeater may sweep multiple beam directions so that the UE gets multiple L1-RSRP measurements for each direction. Repeated measurement resources are needed in the gNB-repeater link. The UE is not aware of that the multiple transmission beam directions are due to gNB or repeater. So the required enhancement may be resource setting and CSI-report setting, from both gNB's perspective and UE's perspective. A2: Some measurement/report respective to repeater is needed, so that gNB can have sufficient information to adopt repeater's Tx power.
4 – Intel Corporation (UK) Ltd 1) Further clarifications on "Objective 1: Support for beamforming" are encouraged. Does it mean Repeater transmission of SSB, SI, … to the UEs or something else? 2) What kind of L1/L2/L3 capabilities are needed at the Repeater side? Given the support of selected L1-L2 functionality, what are the cost advantages over IAB?	Thanks for your questions. A1: SSB transmitted by repeater is an amplified version of the SSB sent by gNB. A2: For the control path, it requires basic full L1/L2/L3 UE capability to support signaling communication with the RAN (TBD as to exact handling). For the data path, it doesn't require any L1/L2/L3 capability and a repeater just amplifies and forwards the signal to/from a UE from/to gNB. The advantage in our view is that no gNB functionality is required to be implemented in the repeater, so it can take advantage of device economies of scale.

Please provide Round 2 questions below.

Feedback Form 12: Round 2 questions

1 – Sony Corporation

Thank you very much for your answers and clarifications. In one of your answers you say that "for pathloss measurement facilitating power control, sending its own RS or the repeater still amplifies and forwards its received RS can be both considered." How is the repeater sending its own RS beneficial for pathloss measurement for power control? Could you please elaborate on that?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 10:

Questions	**Answers**
1 – Sony Corporation Thank you very much for your answers and clarifications. In one of your answers you say that "for pathloss measurement facilitating power control, sending its own RS or the repeater still amplifies and forwards its received RS can be both considered." How is the repeater sending its own RS beneficial for pathloss measurement for power control? Could you please elaborate on that?	As replied in the previous round, we are open to consider all possible solutions. Regarding the approach of sending RS by repeater itself, the repeater may act like gNB sending CSI-RS or a UE sending SRS. It may be beneficial because gNB is fully aware of the RS sending and its corresponding Tx power. Then network side may adjust repeater's Tx power based on the RS measurement. However we would like to study whether legacy power control mechanisms are sufficient or not first.

2.2.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: Support for beamforming (Tx/Rx aspects) [RAN1]

- SSB beam
- System information
- CSI-RS beam for PDCCH/PDSCH
- SRS beam for PUCCH/PUSCH
- Control information and dynamicity

Feedback Form 13: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.2.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: Interference Management [RAN1]

- Support both TDD and FDD

— For TDD: consider same TDD pattern only (i.e. no cross-link interference) and semi-static TDD

- Control mechanism for Repeater Tx power i.e. to gNB/UE to reduce same link interference

Feedback Form 14: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.2.4 Objective 3

Companies are kindly invited to provide their questions to the following objective:

Objective: Repeater Integration and Operation [RAN2]

- Integration: Repeater as a UE with OAM integration

— Initial access, capability reporting, registration & authorization (+ notification to RAN), normal IP connectivity followed by OAM incl. set-up

- Operation: necessary signaling to support Objectives 1 & 2

Feedback Form 15: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.3 RWS-210102 – NTN/TN Spectrum Sharing

2.3.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- Enabling controlled sharing of TN/NTN spectrum to address location-specific connectivity demand.
- Acute shortage of FR1 spectrum for both TN and NTN, esp. in low bands.
- Opportunity for operators to provide global service across TN/NTN with multimode devices
- Complementary demand for TN/NTN spectrum across geographic locations
  - Populated areas: acute TN spectrum demand, poorly utilized NTN spectrum
  - Remote areas: no TN coverage – TN spectrum unused, acute NTN spectrum shortage
- 3GPP - best place to trigger cross-ecosystem discussion
  - 3GPP is the only standards body where NTN and TN co-exist under the same system framework
  - All ecosystem key players can contribute to balanced 3GPP consensus view for regulators to consider

Feedback Form 16: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.3.2 Objective

Companies are kindly invited to provide their questions to the following objective:

Objective: Study NTN – TN spectrum sharing scenario [RAN]

- Explore benefits of network integration between TN/NTN networks to maximize spectrum utilization

— NTN spectrum used by TN networks in densely populated areas

— TN spectrum used by NTN in remote areas with no TN coverage

- Multimode TN/NTN UEs can roam between NTN/TN depending on location

- Identify target spectrum and regulation status

- Scope RAN and core architecture impact

- Scope required NTN/TN co-existence effort

Feedback Form 17: Questions

1 – Sony Corporation Thanks for the contribution. We have two questions.
- How do you ensure that satellite DL transmissions do not interfere with TN transmissions when the satellite is overflying a territory in which TN uses the same frequency as the satellite DL?
- Do you envisage a dynamic spectrum access control entity to control access to NTN/TN spectrum? If so, is there a 3GPP specification impact to incorporate such entities?
2 – Nokia France Where do see appropriate regulations supporting TN-NTN spectrum sharing?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 11:

Sony Questions	**Answers**

How do you ensure that satellite DL transmissions do not interfere with TN transmissions when the satellite is overflying a territory in which TN uses the same frequency as the satellite DL?	It depends on the scenario assumption: If NTN coverage not overlapped with TN coverage (e.g. geographically separated, TN only used for indoor), this problem will not happen. If NTN coverage is overlapped with TN coverage (e.g. overflying), it is still possible to properly manage the beam or frequency allocation to avoid the problem. There are also intermediate options available: partial spectrum sharing could for example an option to deliver minimum service to protect TN/NTN service in the overlap areas. Note that the proposal suggest to first study the scenarios. Technical solution may be discussed later after beneficial scenarios are identified.
Do you envisage a dynamic spectrum access control entity to control access to NTN/TN spectrum? If so, is there a 3GPP specification impact to incorporate such entities?	Static or semi-static spectrum sharing should be the first step. Considering that NTN and TN are both 3GPP systems, it is logical to have a proper mechanism and entity within 3GPP domain for efficient management of spectrum resources. UEs and gNBs may also be able to perform specific measurements to assist network management decisions.

Note: Nokia question was submitted quite some time after the Round 1 deadline, so was not addressed and will be covered in Round 2 response.

Please provide Round 2 questions below.

Feedback Form 18: Round 2 questions

1 – China Telecom Corporation Ltd.

Thanks MediaTek for the good proposal on NTN-TN spectrum sharing. We think this scenario is much useful for remote area coverage. We have two questions for clarification:

1. Does this work only will be done in 3GPP, or need to cooperate with other group, as we know, some satellites companies may not attend in 3GPP.

2. What service does the NTN provide when sharing with TN, e.g. control channel or data channel? Which may impact to the bandwidths NTN provides, and also to the coexistence interference analysis.

2 – Gatehouse Satcom A/S

We do like your contribution in relation to “shared spectrum”. To have NTN and TN to complement each other, and convergence, spectrum co-existence is important.

Do you see it as critical to have shared spectrum for enabling multi-mode?

We do see it as important to study the possible co-existence between NTN and TN to see if it is beneficial to have shared spectrum or not. It is clear that using similar spectrum for both, does simplify, though also requires the specification of situations where both will be availability. Restrictions to indoor / outdoor or geographical location will likely not be sufficient or possible to control the shared spectrum alone.

Study is supported by us.

3 – Sony Europe B.V.

Thank you for your responses to our Round 1 questions.

It seems to us that the scenario where 'TN is only used for indoor' is contrived. We think NTN potential interference to TN exists everywhere outdoors that falls in the footprint of an overflying beam. In some territories, NTN may not yet be licensed and so should not be transmitting on frequencies allocated for TN while overflying such territory. We think that spectrum sharing between TN and NTN should address such issues.

MediaTek Inc. would like to provide the following answers to the above questions

Table 12:

Questions	**Answers**
Nokia – late Round 1 question Where do see appropriate regulations supporting TN-NTN spectrum sharing?	While we understand that regulations are not necessarily enabling this today, we believe that terrestrial MNOs would be able to extend their capacity cost-effectively in remote areas by deploying NTN, and by enhancing capacity via usage of nominal NTN spectrum in TN deployments. The ability for 3GPP to demonstrate support of such sharing would make the 3GPP NTN solution more attractive. Identifying the issues here at an early stage, and in particular any aspects where UE enhancements may be useful, maximises the ability to provide future-proofing for such scenarios
China Telecom Does this work only will be done in 3GPP, or need to cooperate with other group, as we know, somesatellites companies may not attend in 3GPP.	Yes, it is possible that the study in 3GPP may be helpful to other organization/group. It is up to RAN decision on some liaison is needed later.
China Telecom What service does the NTN provide when sharing with TN, e.g. control channel or data channel? Whichmay impact to the bandwidths NTN provides, and also to the coexistence interference analysis.	The initial study scope should start from the beneficial scenario first. There is no pre-assumption on the possible solution. Indeed the interference analysis may be required later after the agreeable scenarios are identified.

Gatehouse We do like your contribution in relation to "shared spectrum". To have NTN and TN to complement each other, and convergence, spectrum co-existence is important. Do you see it as critical to have shared spectrum for enabling multi-mode? We do see it as important to study the possible co-existence between NTN and TN to see if it is beneficial to have shared spectrum or not. It is clear that using similar spectrum for both, does simplify, though also requires the specification of situations where both will be availability. Restrictions to indoor / outdoor or geographical location will likely not be sufficient or possible to control the shared spectrum alone. Study is supported by us.	Thank you for supporting the motivation. Having higher spectrum utilization should be beneficial to both ecosystems to enlarge the economical of scale. It is possible that multi-mode device has better capabilities to support such spectrum sharing scenario. But multi-mode device already has its value from service continuity perspective even without spectrum sharing.
SONY Thank you for your responses to our Round 1 questions. It seems to us that the scenario where 'TN is only used for indoor' is contrived. We think NTN potential interference to TN exists everywhere outdoors that falls in the footprint of an overflying beam. In some territories, NTN may not yet be licensed and so should not be transmitting on frequencies allocated for TN while overflying such territory. We think that spectrum sharing between TN and NTN should address such issues.	Thank you for the comments. Indeed more study will be needed after the beneficial scenarios are identified. Then proper interference analysis could be continued if RAN agree to move forward. But it is suggested Rel-18 start from scenario study first. Whether the technical work can be started in the same release depends on the consensus.

2.4 RWS-210103 – AI/ML Integration

2.4.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- To investigate the benefits of selective AI/ML integration into NG-RAN/AS functions

Feedback Form 19: Questions

1 – LG Electronics France

Q1) We agree that "Extensive study is needed to identify suitable RAN/AS functions for AI/ML integration and to understand how to ensure the quality of AI/ML integration", and your proposal2 is in line with our view in RWS-210233. Do you think ML model provisioning procedure shall be considered in the study? Do you think new performance requirement and test methodologies shall be also studied or can be postponed later?

Q2) On network part, please clarify your view on SON/MDT with AI/ML since the slide mentioned "Continue current MDT/SON work items"?

2 – Nokia Corporation

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

Q1: On page 4, does objective I requires AI/ML in the UE?

Q2: What is proposed by "prediction of user mobility "? Do you refer to trajectory prediction or prediction of network/mobility related decisions to be taken in advance?

3 – Samsung Electronics Polska

RAN3 has started to study load prediction based load balancing/energy saving. What is the difference of the proposed one with the ongoing SI?

4 – Intel Corporation (UK) Ltd

Q: For the proposed RAN1 scope on "optimization with AI-assisted algorithms" could you clarify the definition of such algorithms ? does this mean that instead of replacing certain PHY functions (e.g. PMI codebook) it is optimization of certain existing parameters (e.g. predicting parameters like L etc.)

5 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you very much for the contribution. We have one question for clarification as below:

Q1. What is the criteria to select the use cases for study for different working groups? Do you have some preliminary estimate or some considerations for choosing those? Before sufficient study of the potential use cases, it seems difficult to directly pick one as the pilot example.

6 – NEC Corporation

NEC proposes to have WI in RAN3 as continuation of the current RAN3 SI; to have a new SI in RAN3 as continuation of the current RAN3 SI covering wider scope and use cases. Do you see your proposal on "Study AI/ML integration in both network and device" as part of such RAN3 study or as a separate study?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 13:

Questions	Answers

1 – LG Electronics France Q1) We agree that "Extensive study is needed to identify suitable RAN/AS functions for AI/ML integration and to understand how to ensure the quality of AI/ML integration", and your proposal2 is in line with our view in RWS-210233. Do you think ML model provisioning procedure shall be considered in the study? Do you think new performance requirement and test methodologies shall be also studied or can be postponed later? Q2) On network part, please clarify your view on SON/MDT with AI/ML since the slide mentioned "Continue current MDT/SON work items"?	(Q1) Thanks for the question. We think that ML model provisioning could be briefly highlighted in the study. However, the details of AI-model optimization, different options for distributing the AI-models (training and inference) should be studied separately. We have mentioned the need for such study on AI-ML model optimization in our another Tdoc RWS-210104. If time permits, we think the performance gains using AI should be included to convince ourselves about the efficiency of AI-ML models. (Q2): We believe that current SON-MDT WI can be extended to include AI-ML for predicting network load, down-time and thus optimize the network management and recovery with minimal manual intervention.
2 – Nokia Corporation Thank you for the contribution, some questions for clarification below: Q1: On page 4, does objective I requires AI/ML in the UE? Q2: What is proposed by "prediction of user mobility "? Do you refer to trajectory prediction or prediction of network/mobility related decisions to be taken in advance?	(Q1) Thanks for asking the question. Yes, we believe the AI/ML will be there in the UE. This may be training, or simply inference in UE based on some AI/ML model obtained from network or manufacturer. (Q2) Prediction of user mobility generally means that network or UE can trigger mobility earlier, based on some AI-enabled prediction, so as to improve mobility performance (reduced latency, better robustness, etc.). For example, AI/ML may be used to predict UE trajectory, identify potential target cell, predict the best timing to trigger mobility, etc.
3 – Samsung Electronics Polska RAN3 has started to study load prediction based load balancing/energy saving. What is the difference of the proposed one with the ongoing SI?	We understand that RAN3 may be discussing a related topic. The conclusion from RAN3 SI may be adapted to new frameworks introduced in Rel-18, if any.
4 – Intel Corporation (UK) Ltd Q: For the proposed RAN1 scope on "optimization with AI-assisted algorithms" could you clarify the definition of such algorithms ? does this mean that instead of replacing certain PHY functions (e.g. PMI codebook) it is optimization of certain existing parameters (e.g. predicting parameters like L etc.)	(Q) Thanks for your question. By the term "optimization with AI-assisted algorithms" we intend that certain PHY mechanisms could be optimized by replacing the current PHY functions with AI/ML based learning and predictions. Hence, instead of repeatedly performing complicated PHY functions, the AI/ML based model can be trained to predict it.

5 – HUAWEI TECHNOLOGIES Co. Ltd. Thank you very much for the contribution. We have one question for clarification as below: Q1. What is the criteria to select the use cases for study for different working groups? Do you have some preliminary estimate or some considerations for choosing those? Before sufficient study of the potential use cases, it seems difficult to directly pick one as the pilot example.	Thanks for your question. We think we have limited time, which is not enough to study all the potential use-cases. Hence, depending on time and different companies' preferences and priorities, a subset of use cases should be selected to make the study feasible. Depending on recent activities (e.g. WI etc.) in 3GPP and our own preferences, we have selected the use-cases. For example, as mobility optimization is already a WI in 3GPP, we think we can select this use-case for further study using AI-ML. Similarly, some fundamental PHY functions, like CSI-RS overhead reduction could be selected.
6 – NEC Corporation NEC proposes to have WI in RAN3 as continuation of the current RAN3 SI; to have a new SI in RAN3 as continuation of the current RAN3 SI covering wider scope and use cases. Do you see your proposal on "Study AI/ML integration in both network and device" as part of such RAN3 study or as a separate study?	Thanks for your question. We know there is a proposal to have RAN3 WI and a RAN3 SI as continuation of current RAN3 SI. However, our proposal is a separate study. This will involve RAN1 and RAN2 as well, and will focus on efficiency on using AI for improving some selected MAC/PHY functions.

Please provide Round 2 questions below.

Feedback Form 20: Round 2 questions

1 – vivo Mobile Communication Co. Thanks for your contribution. We notice the proposal of RAN2 leading the study for AI/ML application over air interface. We also notice there might be quite a lot of evaluation involved. Can you share some rationale behind your considerations on the leading WG?
2 – HUAWEI TECHNOLOGIES Co. Ltd. Thank you very much for your answers for the first round. We have one additional question for clarification, for the use case of CSI-RS overhead reduction, is the AI model deployed at gNB or UE? What is the input/output of the AI model?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 14:

Questions	**Answers**
1 – vivo Mobile Communication Co. Thanks for your contribution. We notice the proposal of RAN2 leading the study for AI/ML application over air interface. We also notice there might be quite a lot of evaluation involved. Can you share some rationale behind your considerations on the leading WG?	We selected RAN2 because we felt they have the best overall view of the RAN (including UE) and areas where AI may provide value as well as potential challenges, so if any study starts by identifying use cases, then we feel it would be best to start in RAN2 in the first instance. However, once there is some initial clarity, deeper evaluations on specific use cases may obviously need support from other RAN WGs. If use cases are prioritised already before any study starts, then a different approach may be best.
2 – HUAWEI TECHNOLOGIES Co. Ltd. Thank you very much for your answers for the first round. We have one additional question for clarification, for the use case of CSI-RS overhead reduction, is the AI model deployed at gNB or UE? What is the input/output of the AI model?	Thanks for the question. Proposal was intended for CSI overhead reduction by using MIMO CSI feedback compression. AI models are deployed at UE (compression) and gNB (decompression). Input/output are the channel matrices.

2.4.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: Study AI-assisted AS layer functions for decision quality and/or overhead reduction [RAN2, 1]

- RS overhead reduction and optimization with AI-assisted algorithms [RAN1]
- Mobility predictions, Positioning enhancements [RAN2]

Feedback Form 21: Questions

1 – Beijing Xiaomi Mobile Software

We see benefit to introduce AI in mobility management. Especially in FR2, legacy mobility management can't adopt to the rapidly changing radio channel condition. ML-aided mobility could provide better performance from respective of throughput and ping-pong handover. UE based prediction may be more preferred, considering UE location is a key factor to improve mobility management and UE may refuse to expose location information to NW.

2 – Sony Corporation

Thanks for the contribution. We have a question.

-

For proposal 2 about CSI-RS overhead reduction, does UE need AI/ML trained model for CSI compression? If you have any assumption for CSI overhead reduction, could you clarify about that?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 15:

Questions	Answers
1 – Beijing Xiaomi Mobile Software We see benefit to introduce AI in mobility management. Especially in FR2, legacy mobility management can't adopt to the rapidly changing radio channel condition. ML-aided mobility could provide better performance from respective of throughput and ping-pong handover. UE based prediction may be more preferred, considering UE location is a key factor to improve mobility management and UE may refuse to expose location information to NW.	Thanks for your question. We think we are completely in line with your views. We agree that ML-aided mobility could provide better performance (e.g. reduced latency and improve robustness), particularly in FR2, and UE-based prediction can be explored.
2 – Sony Corporation Thanks for the contribution. We have a question. For proposal 2 about CSI-RS overhead reduction, does UE need AI/ML trained model for CSI compression? If you have any assumption for CSI overhead reduction, could you clarify about that?	Thanks for the question. Yes, for proposal 2 about CSI-RS overhead reduction, the UE will use AI/ML trained model for CSI compression.

Please provide Round 2 questions below.

Feedback Form 22: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.4.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: Study AI-assisted network functions [RAN3, 2]

- Predictive traffic management for load balancing across the network
- Network energy saving
- Radio resource planning and optimizations

Feedback Form 23: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.5 RWS-210104 – AI/ML Traffic

2.5.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- AI adoption has significantly accelerated during the pandemic across all major industries esp. Tech, Finance and Retail
- AI/ML traffic will be a significant portion of mobile network traffic
- It is important to ensure that the 5G System (Core and Access) can fully accommodate such traffic
- SA1 study (22.874) identified following characteristics for AI/ML traffic

— Training data can be distributed

— Learning can be distributed

— Model can be distributed and split

- Based on the above, a study is needed on

— AI traffic and required architecture for AI/ML traffic management.

— Mechanism, e.g. encoding, to optimize AI/ML model transfer overhead

Feedback Form 24: Questions

1 – Nokia Corporation Thank you for the contribution, some questions for clarification below: Q1: Which AI/ML use cases are considered when AI/ML related network traffic increase is assumed for the future? Q2: In those use cases, which messages are carried recently for operating the functionality of the use cases? Q3: Why do we need an encoding mechanisms different than the existing encoding mechanisms? Is there any justification for using different encoding on different type of messages, e.g., AI - non AI related messages?
2 – Qualcomm Incorporated Is the AI/ML traffic study proposal (RWS-210104) for OTT AI/ML applications?
3 – Samsung Electronics Polska RAN3 has started to explore model sharing in ongoing SI. What is the difference of the proposed one with the ongoing SI?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 16:

Questions	Answers

1 – Nokia Corporation Thank you for the contribution, some questions for clarification below: Q1: Which AI/ML use cases are considered when AI/ML related network traffic increase is assumed for the future? Q2: In those use cases, which messages are carried recently for operating the functionality of the use cases? Q3: Why do we need an encoding mechanisms different than the existing encoding mechanisms? Is there any justification for using different encoding on different type of messages, e.g., AI - non AI related messages?	Q1: For example, as mentioned in TR 22.874, Remote driving needs higher UL data rate when the inference is split between the UE and the network. Q2: Based on our understanding to TR 22.874, the AI/ML traffic is regarded as user plane traffic which the UE and the 5G CN do not know what messages from AI/ML traffic are operating which functionality of AI/ML models. Q3: AI/ML models could be often pretty large. Running use cases only in network involve large data transmission (between UE and server) and exposure of privacy. On the other hand, running all use-cases and AI-ML models at the UE incurs high processing time due to limited capabilities of computation, storage and energy of the UE. One possible solution of this is to make UE and network collaborate to achieve a reduced end-to-end latency/energy and maintain private data protection. This requires an efficient split of the AI/ML models between devices and network. For this, intermediate AI-ML model data needs to be transmitted within an application specific latency and maximum allowable data rate. AI-ML specific model encoding (e.g. model sparsification, quantization) is required for AI-ML model optimization and associated traffic management.
2 – Qualcomm Incorporated Is the AI/ML traffic study proposal (RWS-210104) for OTT AI/ML applications	Based on our understanding to TR 22.874, those AI/ML traffic is regarded as user plane traffic that is generated from AI/ML applications
3 – Samsung Electronics Polska RAN3 has started to explore model sharing in ongoing SI. What is the difference of the proposed one with the ongoing SI?	Based on our understanding, RAN3 SI is to study RAN-AI by enhancement of data collection and identify the impact on current NG-RAN node and interfaces. Our proposal based on SA1 study, it is to study how AI/ML applications (user plane) can be supported well in 5G

Please provide Round 2 questions below.

Feedback Form 25: Round 2 questions

1 – vivo Mobile Communication Co. Thanks for your contribution. What is benefit of specifying AI model encoding within scope of 3GPP compared to encoding the AI model

in the application layer?

2 – China Mobile International Ltd

Thanks for the contribution, basically, 5G+AI has two directions, one direction is 5G for AI which I assume is the study undertaking in SA1, and try to investigate the impacts on CN/RAN of AI/ML traffic model. The other direction is AI for 5G which is to utilize AI technique to perform more efficient network optimization. So I think the proposal here is the former one. I have basically two question:

1. AI/ML traffic is user plane data, similar as other OTT appication, which is normally transparent to RAN, the potential impact to RAN to our understanding is perhaps some new QoS requriement may be needed. Besides that, what other RAN impacts do you think?

2. Could you elaborate more on the proposed objectives, it seems out of the control of RAN groups?

— AI traffic and required architecture for AI/ML traffic management.

— Mechanism, e.g. encoding, to optimize AI/ML model transfer overhead

MediaTek Inc. would like to provide the following answers to the above questions:

Table 17:

Questions	**Answers**
1 – vivo Mobile Communication Co. Thanks for your contribution. What is benefit of specifying AI model encoding within scope of 3GPP compared to encoding the AI model in the application layer?	Some of AI use cases (e.g. CSI-RS feedback, mobility, etc.) is be based on low layers. Hence, for those applications the AI encoding cannot be performed in upper layer and can be done only in the low layers. If for some reason, AI application might not do encoding, then 3GPP encoding can help to reduce overhead and delay.
2 – China Mobile International Ltd Thanks for the contribution, basically, 5G+AI has two directions, one direction is 5G for AI which I assume is the study undertaking in SA1, and try to investigate the impacts on CN/RAN of AI/ML traffic model. The other direction is AI for 5G which is to utilize AI technique to perform more efficient network optimization. So I think the proposal here is the former one. I have basically two question: AI/ML traffic is user plane data, similar as other OTT appication, which is normally transparent to RAN,the potential impact to RAN to our understanding is perhaps some new QoS requriement may be needed. Besides that, what other RAN impacts do you think? Could you elaborate more on the proposed objectives, it seems out of the control of RAN groups? — AI traffic and required architecture for AI/ML traffic management. — Mechanism, e.g. encoding, to optimize AI/ML model transfer overhead	Thanks for your comments. We have similar view for 5G for AI and AI for 5G aspects as you mentioned. For question 1, this is reason why stage 2 is need to study whether AI/ML traffic over 5GS has impact on CN/RAN or is only impacted on QoS requirements. One possible impact for RAN is to have encoding/-compression for AI/ML traffic. others may come from stage-2. For question 2, RAN can still consider the mechanism to optimize the AI/ML overhead and latency for channel efficiency. The complete QoS architecture requires SA2 to complete the work.

2.5.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: AI-Encoding for non-split learning methods [RAN2, (3)]

- Study learning method and analyze data redundancy associated with AI/ML models

- AI traffic compression, e.g. AI model encoding, sparsification and quantization

Feedback Form 26: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.5.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: AI-Encoding for split learning methods [RAN2, (3)]

- Model splitting between UE and Server, especially for federated learning

- Model coding for combination of different model compression schemes, e.g. lossy/lossless, quantization, sparsification, and encoding.

- Compression in both training and inference

Feedback Form 27: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions:

To be filled in after Round II

2.6 RWS-210652/RWS-210105 – Mobility Enhancements

2.6.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- Low-performance FR2 mobility is a show-stopper for key services (capacity-hungry low latency): XR, CG.
- Mobility robustness and latency need to be improved

Feedback Form 28: Questions

1 – ZTE Corporation

Q1: It is proposed to study RACH-less inter-cell beam switching. Currently, RACH-less is only supported in LTE in the scenarios that the target TA is equal to the source TA or the target TA is 0. The beam switching is performed by indicating a new TCI state to the UE. How to combine the two features to work together? Some clarification on this is highly appreciated. Thanks.

Q2: Is any enhancement expected to support the back-and-forth cell switching? Or, will the source cell be removed after the cell switching, which is similar as current CHO?

2 – HuaWei Technologies Co.

Q1: Regarding L1/L2 CHO, do you mean UE autonomous switch among cells, but in this case how does the network sync the status of the UE? We have some similar proposal considering L1/L2 triggered mobility, but think such L1/L2 cell switch should be network controlled.

3 – vivo Mobile Communication Co.

Thanks for the good contribution. We are supportive on this working area in Rel-18, with several questions:

1. In objective I, "UE-initiated" is mentioned. We would like to check whether it means to extend L1/L2 mobility being specified in Rel-17 to conditional triggering, or it means UE is just responsible for initiation, but network to handle the switching?
2. For objective II, we would like to check the corresponding use case for bullet 1-3.

4 – Nokia Corporation

questions and comments on RWS-210105

We share your view that mobility enhancements are important area for Rel-18 enhancements.

Does the first objective (i.e. L1/L2 based CHO triggering) assume the stored RRC reconfiguration is executed based on L1/L2 measurements/triggers? Or RRC configuration remains the same, while the UE changes just the lowe-layer config?

What is beam switching delay that is mentioned in your proposal? Is this the signaling delay that is needed for beam switch command or the delayed beam switch procedure due to delayed measurements? What is the amount of delay that is targeted to be reduced in these cases?

Within the second objective, inter-cell beam switching is meant to work between two serving cells or from a serving cell to a neighbour? Does 'Active set' imply the resemblance to UTRA solution or something different?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 18:

Questions	Answers
1 – ZTE Corporation Q1: It is proposed to study RACH-less inter-cell beam switching. Currently, RACH-less is only supported in LTE in the scenarios that the target TA is equal to the source TA or the target TA is 0. The beam switching is performed by indicating a new TCI state to the UE. How to combine the two features to work together? Some clarification on this is highly appreciated. Thanks. Q2: Is any enhancement expected to support the back-and-forth cell switching? Or, will the source cell be removed after the cell switching, which is similar as current CHO?	**A1.** Thanks for the questions. As you mentioned, beam switching is performed by indicating a new TCI state to the UE, and this is considered for inter-cell mobility in Rel-17. However, it is unclear (at least for "handover-like" scenario) whether RACH is needed when UE is indicated a TCI state of different cell (usually non-collocated). If yes, the latency of inter-cell beam switching would be comparable to L3 mobility, and the benefit of L1/L2-centric mobility is limited. Therefore, we suggest that inter-cell beam switching should be RACH-less. To achieve this (when target TA is non-zero or not equal to source TA), one possible method is to allow UE to maintain DL & UL synchronization to cells in an "active set", and then UE can do fast switching within the active set using inter-cell beam switching. We note that TA difference does not need to be 0 for RACH-less to take place. The feasibility and methods can be investigated in Rel-18, as one objective proposed by us. **A2.** With the "active set" configuration, UE can store source cell configurations and skip reconfiguration for back-and-forth cell switching; tis further reduces cell switching latency.
2 – HuaWei Technologies Co. Q1: Regarding L1/L2 CHO, do you mean UE autonomous switch among cells, but in this case how does the network sync the status of the UE? We have some similar proposal considering L1/L2 triggered mobility, but think such L1/L2 cell switch should be network controlled.	**A1.** Thanks for the questions. In Rel-17 L1/L2 mobility (though it's unclear whether "handover-like" scenario will be supported in Rel-17) and our Objective 2, the cell switch is network-controlled. However, in RRC-based handover, we do have CHO procedure, in which handover execution (to a pre-configured candidate) is triggered by UE. The proposed "L1/L2 CHO" objective, as its name suggests, is to have the execution of L1/L2 mobility triggered by UE, and the expected benefit is improved robustness. The detailed procedures can be discussed in Rel-18, for example: With L1/L2 CHO, UE sends L1/L2 signal to selected candidate cell when pre-configured conditions are met, and network responds with another L1/L2 signal to complete the cell switch. Alternatively, UE may send L1 measurement results or even SRS-like signal to target cell, and target cell triggers cell switching (This may not be a "CHO", but can still be considered).

3 – vivo Mobile Communication Co. Thanks for the good contribution. We are supportive on this working area in Rel-18, with several questions: 1. In objective I, "UE-initiated" is mentioned. We would like to check whether it means to extend L1/L2 mobility being specified in Rel-17 to conditional triggering, or it means UE is just responsible for initiation, but network to handle the switching? 2. For objective II, we would like to check the corresponding use case for bullet 1-3.	**A1.** Thanks for the questions and supporting this working area in Rel-18. By "UE-initiated", our intention is to allow UE communication with target cell for cell switching, so as to improve robustness. This can be a conditional triggering to a pre-configured candidate cell (i.e. L1/L2 version of CHO). Alternatively, UE may send L1 measurement results or even SRS-like signal to target cell, and based on which target cell triggers cell switching. Notice that Rel-17 L1/L2 mobility may eventually not support "handover-like" scenario; in that case we may consider Rel-17 leftovers in this objective. **A2.** Here are further explanations of each bullet Active set: A set of pre-configured and pre-synchronized cells, among which UE can do fast inter-cell beam switching RACH-less inter-cell beam switching: UE should be able to skip RACH upon inter-cell beam indication, otherwise the latency is not reduced by L1/L2 mobility. We can study how to enable RACH-less cell switching, at least within the active set. (NW) Predictive beam management: Predict the next serving beam and triggers beam switching earlier. In this way, even if some latency is not avoidable, UE switches to target beam/cell when target becomes the best.

4 – Nokia Corporation We share your view that mobility enhancements are important area for Rel-18 enhancements. Does the first objective (i.e. L1/L2 based CHO triggering) assume the stored RRC reconfiguration is executed based on L1/L2 measurements/triggers? Or RRC configuration remains the same, while the UE changes just the lowe-layer config? What is beam switching delay that is mentioned in your proposal? Is this the signaling delay that is needed for beam switch command or the delayed beam switch procedure due to delayed measurements? What is the amount of delay that is targeted to be reduced in these cases? Within the second objective, inter-cell beam switching is meant to work between two serving cells or from a serving cell to a neighbour? Does 'Active set' imply the resemblance to UTRA solution or something different?	**A1.** Thanks for your questions and supporting mobility enhancements for Rel-18 enhancements. For the "L1/L2 CHO" objective, Our intention is to allow conditional triggering of L1/L2 mobility procedure, so as to guarantee the robustness. Whether RRC reconfiguration can be executed depend on conclusion of Rel-17 (network-triggered) L1/L2 inter-cell mobility. If this is supported in Rel-17, it can be extend to the proposed L1/L2 CHO. We may need to deal with Rel-17 leftovers (e.g. the "handover-like" scenario) in Rel-18. **A2.** Our response to the questions are listed below: The "beam switching delay" refers to the overall delay from a UE identifying a good target cell/beam to UE accessing the target cell. It includes (1) measurement reporting and (inter-cell) beam indication, (2) UE reconfiguration, (3) non-serving cell beam measurement and DL synchronization, and (4) RACH towards target cell. If UE can be pre-configured for and pre-synchronized to candidate cells, (2) to (4) can be saved, which means around 75ms delay reduction. If predictive mobility is possible, beam/cell switching can be triggered even before measurement reporting, (1) can also be saved. Our intention is to allow these at least in an "active set" In our opinion, inter-cell beam switching is meant to work from a serving cell to a neighbour; it is not a CA-like scenario where multiple serving cells are configured and UE do fast switching among them with activation/deactivation. But this issue is also under discussion in Rel-17, and we can adjust this part according to Re-17 conclusion. The "active set" is different from UTRA one in that we do not require UE to receive from multiple cells simultaneously. The intention is to form a set of cells among which UE can do fast switching by pre-configuration and pre-synchronization.

Please provide Round 2 questions below.

Please note that a NEW version of our document - which adds simulations results - has been uploaded (RWS-210652).

Feedback Form 29: Round 2 questions

1 – HuaWei Technologies Co.

Thanks for the detailed clarifications. We are also quite interested in the dynamic approach of ”L1/L2 mobility” and think this should be included in the mobility discussion in Rel-18, and NW-triggered and/or UE-triggered can be discussed at a later stage.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 19:

Questions	**Answers**
1 – HuaWei Technologies Co. Thanks for the detailed clarifications. We are also quite interested in the dynamic approach of “L1/L2 mobility” and think this should be included in the mobility discussion in Rel-18, and NW-triggered and/or UE-triggered can be discussed at a later stage.	Thanks for your interest. We would be fine to consider designing the procedure for the dynamic/fast cell switching with L1/L2 mobility, and then discuss the possibility of UE-triggered mobility with that procedure.

2.6.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: L1/L2-triggered CHO [RAN2, 1, 4] *[subject to R17 status]*

- Pre-configuration of candidate cell(s) i.e. Intra-CU, incl. intra- and inter-DU, candidate set
- UE-initiated cell switching with L1/L2 trigger, i.e. UE activation of inter-cell TCI states

NOTE: R17 FeMIMO addressing *NW-initiated* L1/L2 mobility

Feedback Form 30: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions:

To be filled in after Round II

2.6.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: Inter-cell, Intra-cell beam switching delay reduction [RAN1, 2, 4]

- Active set (i.e. several cells) for fast inter-cell beam switching
- RACH-less inter-cell beam switching

- (NW) Predictive beam management [Link with AI/ML integration, See Section 2.4]

Feedback Form 31: Questions

1 – Lenovo (Beijing) Ltd

RACH-less inter-cell beam switching is restricted to the case of same TA, known TA and zero TA. Do you want to focus on RACH-less case? or support both RACH and RACH-less case?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 20:

Questions	**Answers**
1 – Lenovo (Beijing) Ltd RACH-less inter-cell beam switching is restricted to the case of same TA, known TA and zero TA. Do you want to focus on RACH-less case? or support both RACH and RACH-less case?	**A1.** Thanks for the questions. Our intention here is to address the need of RACH in L1/L2-centeric inter-cell mobility. While this Rel-17 objective aims at latency reduction, if RACH needs to be performed upon inter-cell beam indication, the latency of inter-cell beam switching would be comparable to L3 mobility. Therefore, we suggest that inter-cell beam switching should be RACH-less. To achieve this (when target TA is non-zero or not equal to source TA), one possible method is to allow UE to maintain DL & UL synchronization to cells in an "active set", and then UE can do fast switching within the active set using inter-cell beam switching. This can be seen as "know TA" you mentioned. In addition, as our reply to ZTE, TA difference does not need to be 0 to justify RACH-less. The feasibility and methods can be investigated in Rel-18.

Please provide Round 2 questions below.

Feedback Form 32: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions:

To be filled in after Round II

2.6.4 Objective 3

Companies are kindly invited to provide their questions to the following objective:

Objective: DAPS enhancement [RAN2, 4]

- Enable RRC-based DAPS handover in FR2 for multiple-panel UE

Feedback Form 33: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions:

To be filled in after Round II

2.7 RWS-210106 – System Energy Enhancements

2.7.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- Need to balance system capacity and energy efficiency
- UE/NW cooperation for improved system-wide energy efficiency

Feedback Form 34: Questions

1 – vivo Communication Technology

[vivo]

Thanks for the nice paper. We agree it is time and important to consider power optimization jointly for NW and UE side. In particular, we have following questions for better understanding.

2 – China Telecomunication Corp.

Thanks a lot for the good contribution for system energy enhancements which includes both UE energy saving and network energy saving.

We also see the need to have a dedicated SI/WI to have a comprehensive study of network energy saving in R18. And we are interested in the objective"Dynamic network power saving via gNB/TRP/beam dormancy".

We agree that developing evaluation methodology and power consumption model is very important for this topic since it provides a method to identify effective energy saving solution. Regarding this, we have two questions: Does the evaluation methodology mentioned in the contribution only consider single gNB/UE? If yes, will MediaTek consider the evaluation methodology for mutiple gNBs scenario?

3 – CATT Our understanding is that network energy saving would be performed when there is low traffic and no traffic for UEs. We would like to clarify whether and how the network energy saving impacts to the system capacity.
4 – NTT DOCOMO INC. Thank for the good contribution. power saving for multi-TRP and dynamic network power saving with dormancy are independent respectively, or they have some relationship? If they have relationship, could you elaborate it more?
5 – HUAWEI TECHNOLOGIES Co. Ltd. Thank you very much for the contributions. Please find some questions for clarification as below: 1. For ”enable DCI-based power saving adaptation for multi-TRP and multi-panel”, it seems to require the UE support mTPR first. Do you consider power saving for single TRP case, e.g. adpative Tx/Rx on-off? 2. For ”dynamic network power saving via gNB/TRP/beam dormancy”, do you think it can be applied to PCell as well?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 21:

General Clarification: **G1**: NR R16 and R17 have established useful evaluation methodology and power saving adaptation framework that can be extended for improving system (NW + UE) energy efficiency in R18. Specifically, The evaluation methodology for UE power consumption analysis is based on logging UE operations for each DL/UL in a system-level simulation. Augmenting the log with the operations of network nodes and including the power consumption models of network nodes can extend the evaluation methodology for system energy efficiency analysis (Objective 3). When UE is adapted into reduced reception in time/frequency/MIMO-layer domain, it also implies the power saving opportunity for network side. In this regard, existing dynamic UE power saving adaptation can be extended for dynamic network power saving in R18. The key factors for the extension can include resolving the conflict between dynamic UE power saving adaptation and multi-TRP operation (Objective 1), efficient cell/TRP/beam-wise indication for the power saving adaptation and UE assistance mechanism to accommodate long cell/TRP/beam dormancy (Objective 2)	

1. vivo	***A1:*** Thanks for the comments. The questions seem missing, and we will reply your questions to for the following Objectives.
2. China Telecomunication	***A1:*** Thanks for the comments. Please refer to G1 in the above "General Clarification" for the information of extended evaluation methodology. In particular, the methodology needs to include multiple gNBs and UEs, as in typical system-level evaluation. Multi-TRP operations are suggested to be included for the usefulness and popularity. Whether to include relay, repeaters and IAB can be further discussed during the work scoping.
3. CATT	***A1:*** Thanks for the question. Please first refer to G1 in above "General Clarification" for the suggested way forward to develop dynamic power saving schemes for network. Since the dynamic mechanism will impact DL/UL activities of both network and UE, check on the impact to data throughput and/or average packet latency will be necessary for the best balance between spectrum efficiency and system energy efficiency.
4. NTT DoCoMo	***A1:*** Thanks for the question. As commented in G1 of "General Clarification", UE power saving mechanism can be extended for network power saving. When network is equipped with multi-TRP operations, Objective 1 is to enable dynamic power saving adaptation *per TRP* where new "UE adaptation behaviour" should be specified. On the other hand, Objective 2 is related to signalling designs and mechanisms that can start or end the time duration for gNB/TRP/beam dormancy where DL/UL activities of both network and UE sides are expected to be suspended for power saving purpose.

5. Huawei	***A1:*** Thanks for the question. Objective 1 is to resolve the feature interaction issue between multi-TRP and DCI-based power saving adaptation, and there is indeed assumption of UE support of multi-TRP (including multi-DCI support). As commented in G1 of "General Clarification", UE power saving mechanism can be extended for network power saving, and Objective 1 is to enable dynamic power saving adaptation *per TRP* for the multi-TRP case. For single TRP case, adaptation on UE antenna number was discussed in Rel-16 but there is no consensus for further specification. But, we think UE is allowed to disable its (part of) antennas during gNB/TRP/beam dormancy, thus achieving better system energy efficiency. ***A2:*** Thanks for the question. gNB dormancy can be regard as PCell dormancy. Despite of the power saving benefit, cautions should also be taken to ensure system performance metrics.

Please provide Round 2 questions below.

Feedback Form 35: Round 2 questions

1 – vivo Communication Technology

Sorry for missing the question list in the 1st round due to editorial problems. resend the questions as below...

Thanks for the nice paper. We agree it is time and important to consider power optimization jointly for NW and UE side. In particular, we have following questions for better understanding.

(1) In P5, TRP-level dynamic power adaptation is proposed, it seems to us that Rel-17 SSG switching framework can be utilized to serve this purpose at least for PDCCH monitoring adaptation perspective, and would be good to know what additional enhancement that MTK has in mind? And it is not very clear to us how much power saving gain can be obtained by UE monitoring single TRP compared with two TRPs based on the current power model, do we need to update the power model for mTRP case?

(2) In P6, it is mentioned gNB/TRP/beam dormancy: Target "second-wise" and "(10) ms-wise" and good NW power saving gain is shown. We wonder does "second-wise" and "(10) ms-wise" corresponds to the long and short dormancy concept as shown in P7?

(3) In P7-case 1, i.e. long dormancy, we wonder what is the assumed RRC state (RRC connected, or RRC IDLE) for UE to send the UL notification signal to NW?

(4)In P7-case 2, i.e. short dormancy, is it somehow related to the TRP-specific power adaptation as proposed in P5?

2 – vivo Communication Technology

Sorry, please ignore the repeated questions above. We may provide additional questions and comments to the individual objectives further.

3 – Apple Italia S.R.L. Thanks for the contribution. In general we agree that any study should consider both the gNB and UE power consumption and the system performance impact.
4 – ZTE Corporation Thanks for the contribution. Regarding the unified system-wide energy efficiency metric for both NW and UE, whether/how to take UE with diverse capabilities into consideration?
5 – China Mobile International Ltd We acknowledged the motivation of system-wide energy efficiency. In our view, network energy saving should not sacrifice the network capacity and user experience, this is also the principle in our 4G/5G network operation

MediaTek Inc. would like to provide the following answers to the above questions:

Table 22:

General Clarification: ***G4:*** Joint network and UE power saving should be the specific design target for R18 power saving enhancements for the following reasons: Identify and develop win-win solutions for NR system energy efficiency Avoid diverse power saving features and feature interaction/compatibility issues in R18	
1. vivo	***A1:*** Thanks for the response. We will reply your further question specific for Object 1 below.
2. vivo	
3. Apple	***A1:*** Thanks for the comment. We think joint network and UE power saving should be the design target so as to develop win-win power saving solutions for Rel-18, as clarified in ***G4*** above.

4. ZTE	***A1:*** Thanks for the question. For connected-mode UEs, network is able to know their capabilities, and network implementation should be able to UEs of different capabilities and maximize the joint network and UE power saving gain. For idle-mode UEs, R18 will need to provide baseline feature(s) subject to R15 UE limitation. For example, extension of SS burst period is limited up to 160 ms, and advanced design(s) targeting longer SS burst periodicity needs to avoid impact to legacy UEs.
5. CMCC	***A1:*** Thanks for sharing CMCC view. One practical way to achieve your goal is to joint network and UE power saving as the design metric for Rel-18 power saving features, as clarified in ***G4*** above. This is challenging but necessary to move next level of power saving enhancements for R18.

2.7.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: Enable DCI-based power saving adaptation for multi-TRP and multi-panel [RAN1, RAN4]

- TRP-specific DCI-based power saving configurations and UE adaptation behaviors for multi-TRP and multi-panel operations

Feedback Form 36: Questions

1 – vivo Communication Technology [vivo] In P5, TRP-level dynamic power adaptation is proposed, it seems to us that Rel-17 SSG switching framework can be utilized to serve this purpose at least for PDCCH monitoring adaptation perspective, and would be good to know what additional enhancement that MTK has in mind? And it is not very clear to us how much power saving gain can be obtained by UE monitoring single TRP compared with two TRPs based on the current power model, do we need to update the power model for mTRP case?
2 – CATT From the network energy saving study for LTE in Rel-10, the gNB energy saving comes from the RF chain ON/OFF at the gNB, which is system-wise operation. We don't think the UE specific operation in DCI-based indication would provide any network energy saving

3 – Qualcomm communications-France Could you please clarify ”TRP-specific DCI-based adaptation”? Under which scenarios can’t we leverage R16/17 UE power techniques to mTRP/multi-panels
4 – LG Electronics Polska Expected power saving gain from the DCI-based power saving adaptation for multi-TRP is not clear. Could you explain more how much power saving gain (briefly) can we expected with this method? Regarding for multi-panel adaptation, in my understanding, UE does not need to know about the number of panels that is currently used by the gNB. Could you explain little more what kind of specification impact would be expected for the DCI-based UE adaptation behaviors for multi-panel operations?
5 – Spreadtrum Communications Thanks for the quality contribution. For UE power saving with multi-TRP, we think the TRP-specific DCI based adaptation can be considered to specify in R18 as a spatial domain power saving technique. As well, some other enhancements for DCI-based DRX adaptation can be also considered as mentioned in our contribution [RWS-210064]. All potentional enhancement for DCI-based adaptation (including DRX adaptation) can be listed and specified (if necessary) in R18. In our view, only considering TRP-specific enhancement may be too narrow.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 23:

General Clarification: **G2**: While multi-TRP operation assume a common BWP setting for data scheduling from both TRPs, DCI-based UE power saving adaptation can change to a different BWP setting per DCI indication from any TRP. If there is no perfect alignment between two TRPs, UE can miss the data scheduling from the other TRP just in next slot (e.g. when the scheduling offset K0 is changed from 0 to 1 or the next slot is indicated to be skipped by one TRP). To avoid such issue, perfect alignment between two TRPs for any power saving adaptation indication should be ensured to every UE, which will pose stringent requirement (and alignment overhead) for network to operate both features, which is also the reason we assume only DRX will be used with multi-TRP in slide 5 of RWS-210106. Instead of requiring perfect TRP alignment, defining UE behaviours to accommodate per-TRP power saving adaptation will be more practical. As commented in G1, the per-TRP UE power saving adaptation can also be extended for TRP power saving, as part of the target in Objective 2.	

1. vivo	***A1:*** Thanks for the question. Please refer to G2 of the above "General Clarification" for the explanation on the conflict between multi-TRP operation and any DCI-based power saving scheme. Since R15 BWP adaptation and R16 SCell dormancy will also encounter the same issue, a generic solution for all DCI-based power saving schemes should be developed. ***A2***: Thanks for the question. As commented in G2 of the above "General Clarification", the conflict between multi-TRP operation and any DCI-based power saving scheme can cause network to apply only DRX with multi-TRP, causing significant (42% - 59%) power saving gain loss compared with the case DCI-based power saving schemes can be applied.
2. CATT	***A1:*** Thanks for the question. Objective 1 is to enable per-TRP power saving indication that can be extended to enable TRP-wise power saving (dormancy). Also the target of the suggested item is system energy efficiency where UE power consumption issue with multi-TRP operations should also be resolved as well.
3. Qualcomm	***A1:*** Thanks for the question. Please refer to G2 of the above "General Clarification" for more detailed information. Further comment(s)/question(s) is welcomed.

4. LG Electronics	***A1:*** Thanks for the question on power saving gain. As commented in G2 of the above "General Clarification", the conflict between multi-TRP operation and any DCI-based power saving scheme can cause network to apply only DRX with multi-TRP. In slide 5 of RWS-210106, we show significant (42% - 59%) power saving gain loss compared with the case DCI-based power saving schemes can be applied. ***A2***: Thanks for the question on multi-panel operations. We assume UE multi-panel operations are inherent in order to support multi-TRP transmissions requiring different reception beamforming. When UE is indicated to enter power saving from one TRP, UE can reduce the power consumption of the active panel for that TRP. Potential specification impact to realize per-TRP power saving adaptation can focus on defining necessary new UE behaviours not specified for single-TRP scenario.
5. Spreadtrum	***A1***: Thanks for the comments. We are aligned with investigating spatial domain enhancements for power saving adaptation. The reason we doesn't include DRX enhancement for XR is that R17 enhancement on PDCCH monitoring reduction should be sufficient to handle frequent data traffic. Since the frequency-domain and time-domain power saving adaptations have been extensively studied and specified, resolve the issue as clarified in G2 of "Generic Clarification" looks the remaining critical step.

Please provide Round 2 questions below.

Feedback Form 37: Round 2 questions

1 – vivo Communication Technology [vivo] For TRP-specific DCI-based power saving configurations and UE adaptation, if the UE monitors one TRP instead of multiple TRPs, the UE PDCCH blind decoding is reduced. We are wondering whether the power saving gain comes from reduced BD/CCE number for dynamic TRP-specific adaptation.
2 – Apple Italia S.R.L. Thanks for the more detailed explanation on the intended use case. But as far as we understand, mTRP is not really tied with multi-panel. Even with multi-panel, different BWP operation on different TRP is not always possible. It is also not entirely clear to us why there is a strong motivation to enable per-TRP

operation for BWP switching and SCell dormancy. By making it per-TRP, the UE power saving benefit is very much reduced. The existing mechanism only requires some coordination between the TRPs, which is generally assumed to be available between the TRPs (may not be ideal, but should be mostly fine for this purpose).

3 – Spreadtrum Communications

Thanks for the clarifications.

For UE power saving with multi-TRP, we still think it is too narrow if only TRP-specific power saving is considered. We prefer to revisit the adaptive DRX and PDCCH monitoring reduction including XR use case. Maybe the low-power wakeup receiver can be discussed together...

MediaTek Inc. would like to provide the following answers to the above questions:

Table 24:

General: <general answer if applicable>	
1. vivo	***A1:*** Thanks for further question. Major power saving is not from reducing the monitoring complexity for multi-TRP. It comes from enabling joint deployment of DCI-based power saving adaptation and multi-TRP. As clarified in ***G2*** (first row in Round I response), there is issue for co-operating the two features, and network may only apply very baseline DRX with multi-TRP. The identified power saving gain (42% - 59%) is from enabling DCI-based power saving schemes with multi-TRP.
2. Apple	***A1:*** Thanks for the questions. For the requirement on TRP-coordination for DCI based power saving schemes, the timing requirement should be within a slot or shorter, as clarified in ***G2*** (first row in Round I response). Also the frequency is as high as per packet start/end per UE. Such tight timing requirement and intensive frequency will cause additional network cost. It is therefore desirable to enable per-TRP adaptation and allow network to flexibly indicate joint TRP and UE power saving whenever a TRP finish UE data transmission. Although this enhancement requires additional UE behaviors, the pay-back is ease of co-operating DCI-based power saving schemes with multi-TRP (providing 42% - 59% of UE power saving gain). In this regard, it is an good example of win-win solution as targeted for R18 power saving designs.

3. Spreadtrum	***A1:*** Thanks for further comment. We are supportive to have a joint power saving item in R18, covering both network and UE aspects. TRP-related power saving is suggested because: There is interaction issue with existing UE power saving features and multi-TRP feature TRP-wise power saving is part of network power saving Although the above is an good example of joint network and UE power saving design, R18 power saving scope is not restricted to it. Further email discussion is expected to converge an inclusive scope for R18 power saving enhancements.

2.7.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: Dynamic network power saving via gNB/TRP/beam dormancy [RAN1, (RAN2)]

- gNB wake-up mechanism (triggered by UE) for gNB/TRP/beam dormancy
- Dynamic group indication for gNB/TRP/beam dormancy

Feedback Form 38: Questions

1 – vivo Communication Technology [vivo] (1) In P6, it is mentioned gNB/TRP/beam dormancy: Target "second-wise" and "(10) ms-wise" and good NW power saving gain is shown. We wonder does "second-wise" and "(10) ms-wise" corresponds to the long and short dormancy concept as shown in P7? (2) In P7-case 1, i.e. long dormancy, we wonder what is the assumed RRC state (RRC connected, or RRC IDLE) for UE to send the UL notification signal to NW? (3) In P7-case 2, i.e. short dormancy, is it somehow related to the TRP-specific power adaptation as proposed in P5?
2 – CATT Since NR is network-controlled operation, gNB could decide the time to have RF chain ON/OFF based on the traffic at the slots without traffic and always-on signals. UE is a client to the network and does not know where the network location and and the connection are. The UE-triggered gNB wakeup is not a realistic scheme to provide gNB energy saving in the network-controlled NR operation.

3 – KT Corp. We would prefer to see this objective part came out as a separate SI and focus on system energy enhancement on gNB side.
4 – Spreadtrum Communications Thanks for the quality contribution. For network power saving, we think wakeup notification from UE may be beneficial for network energy reduction. The low-power wakeup receiver at gNB can be studied together with the low-power wakeup receiver at UE side, which has been proposed by serveral companies.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 25:

General Clarification: **G2**: While multi-TRP operation assume a common BWP setting for data scheduling from both TRPs, DCI-based UE power saving adaptation can change to a different BWP setting per DCI indication from any TRP. If there is no perfect alignment between two TRPs, UE can miss the data scheduling from the other TRP just in next slot (e.g. when the scheduling offset K0 is changed from 0 to 1 or the next slot is indicated to be skipped by one TRP). To avoid such issue, perfect alignment between two TRPs for any power saving adaptation indication should be ensured to every UE, which will pose stringent requirement (and alignment overhead) for network to operate both features, which is also the reason we assume only DRX will be used with multi-TRP in slide 5 of RWS-210106. Instead of requiring perfect TRP alignment, defining UE behaviours to accommodate per-TRP power saving adaptation will be more practical. As commented in G1, the per-TRP UE power saving adaptation can also be extended for TRP power saving, as part of the target in Objective 2. **G3 (Reasons behind Objective 2)**: While gNB can realize power saving without informing UE, UE UL activities can reduce the effectiveness of its power saving. In this regard, a “dormancy” time duration in which DL/UL activities of both network and UE sides are explicitly suspended can maximize the power saving gain for both sides. To enable a long dormancy time duration for gNB/TRP/beam, preventing wake-up unless there is critical request from UE for coverage or QoS is demanded. Therefore, gNB wake-up mechanism triggered by UE only when necessary is suggested in Objective 2.	

1. vivo	***A1:*** Thanks for the question. Yes, "second-wise" and "(10) ms-wise" time durations are reasonable targets for long dormancy and short dormancy, respectively. But, the dormancy time duration can be a configured parameter to accommodate flexible use cases/scenarios. ***A2***: Thanks for the question. If the dormancy time duration is 1 second, idle/inactive mode should reasonably be the targeted state. But if the duration is 100 ms, it is still possible for connected mode. It is useful if Objective 2 can lead to a generic mechanism with flexible dormancy time duration parameter. ***A3***: Thanks for the question. Yes, and please refer to G2 of the above "General Clarification". In particular, the per-TRP power saving adaptation of Objective 1 can be extended for realizing TRP-wise power saving/dormancy as targeted in Objective 2.
2. CATT	***A1:*** Thanks for the comment. Please refer to G3 of the above "General Clarification" for the reasons behind Objective 2. Since we assume micro/pico cell is OFF while macro cell is still ON, micro/pico cell information can still be available to UE (via macro cell broadcast information). Further question(s)/comment(s) is welcomed.
3. KT	***A1:*** Thanks for the comment. Please refer to G1 in the "General Clarification" for the motivation of the WI. When UE is adapted into reduced reception in time/frequency/MIMO-layer domain, it also implies the power saving opportunity for network side. In this regard, existing dynamic UE power saving adaptation can be extended for dynamic network power saving in R18. Also, we would like to suggest expanding the scope of network energy saving to system energy efficiency so that both network and UE can cooperate and achieve better power saving benefit for both sides, as clarified in G3 of the above "General Clarification".
5. Spreadtrum	***A1***: Thanks for the comments. Ultra-low-power wake-up is an interesting idea, which may have potential application to gNB wake-up mechanism. It is not excluded in the scope of Objective 2.

Please provide Round 2 questions below.

Feedback Form 39: Round 2 questions

1 – Apple Italia S.R.L. We wonder how such schemes would impact the legacy UEs, especially those in idle state. Alternatively, how can we avoid the impact on the legacy UEs.
2 – Spreadtrum Communications Thanks for the clarifications. For network power saving, it seems that MTK prefer the receiver based network power saving which is the principle of UE power saving. In our view, the power consumption of transmission at network seem larger than that of reception at network, e.g. SSB/TRS/CSI-RS... Do you also plan to reduce the power consumption of transmission at network?
3 – China Mobile International Ltd Generally, in our view, solutions for network energy saving should allow early implementation, i.e., not largely rely on terminal assistance, the main reason is, if one of the features has some UE impacts, the earliest time the operator could commercialize the feature will be around 2025, since this is Rel-18, but the solutions of energy saving for 5G is more urgent. So the general comments is in Rel-18 we could think energy saving from network side point of view and some UE assitence could be considered if needed.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 26:

Answers	
1. Apple	***A1:*** Thanks for the question. For idle-mode UEs, R18 system power saving needs to provide baseline feature(s) subject to R15 UE limitation. For example, extension of SS burst period should be limited up to 160 ms, and advanced design(s) targeting longer SS burst periodicity needs to be examined for avoiding impact to legacy UEs.
2. Spreadtrum	***A1:*** Thanks for further comment and question. The suggested gNB/TRP/beam dormancy is to allow both network and UE not to transmit or receive anything during a period of time for a gNB/TRP/beam. We are not restricted to "receiver-based" power saving solutions for network, and saving of SSB/TRS/CSI-RS transmission is included.

Note: China Mobile comment was provided after the deadline, so was not addressed unfortunately.

2.7.4 Objective 3

Companies are kindly invited to provide their questions to the following objective:

Objective: Evaluation methodology for system energy efficiency [RAN1]

- Develop gNB/TRP/beam power consumption model
- UE power consumption model extension for multi-TRP and multi-panel operations

Feedback Form 40: Questions

1 – CATT Evaluation methodology is an essential for network energy saving. However, the power model for gNB power consumption is more complicated and diverse by different gNB vendors due to different selection of network configuration and implementation.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 27:

1. CATT	***A1:*** Thanks for the comment. We understand the difficulty. But, for quantitative study and identification of effective solutions, extending the evaluation methodology in TR 38.840 should be still be pursued.

Please provide Round 2 questions below.

Feedback Form 41: Round 2 questions

1 – Apple Italia S.R.L. We also see the challenge in defining the power model for gNB. But we agree that if we want to study network power saving, a power model is necessary.
2 – China Mobile International Ltd Power model for gNB is an interesting topic, we are also thinking about defining energy saving modes in standard, except for cell on/off

MediaTek Inc. would like to provide the following answers to the above questions:

Table 28:

1. Apple	***A1:*** Thanks for your comment.

NOTE: China Mobile comment was provided after the deadline so not addressed unfortunately.

2.8 RWS-210107 – Positioning Enhancements

2.8.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation:

- A number of use cases call for improved positioning accuracy down to cm level whether indoor or outdoor e.g. industry automation, logistics, automotive, healthcare and public safety etc.

- Support for Sidelink for both absolute and relative positioning

- Support for Redcap UEs due to lower bandwidth

Feedback Form 42: Questions

1 – CATT

CATT has the similar views with MTK on the R18 positioning enhancements, SL positioning, and possible left-over issues of R17, including RedCap support, the SRS enhancement, accuracy improvement via CA.

Questions:

Q1: In our understanding, carrier phase measurements can be obtained from existing DL PRS/UL SRS, or adding new very narrow band signals for continuous carrier phase measurements. In MTK's Objective 1, does the *Transmission* related to signal phase mean the transmission of the existing DL PRS/UL SRS, or new very narrow band signals for continuous carrier phase measurements?

Q2: NR carrier-phase positioning may have specially application for SL positioning. For example, once one UE is phase-locked to another UE, any changes of the relative between the two UEs can be monitored precisely from the change of the carrier phase measurements even without the need to resolve the integer ambiguity. What is MTK' s view on supporting SL carrier-phase positioning?

Q3: For the self-calibration for group delay, can MTK explain how it can be done, and whether it is performed dynamically?

2 – ZTE Corporation

(1) On objective I in P4, what kind of enhancement do you expect to achieve cm-level accuracy for NR?

(2) On objective IV in P4, Rel-18 Mid/low-Tier UE enhancement may also consider minimum 5 MHz bandwidth, do you also consider it?

3 – Beijing Xiaomi Mobile Software

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

4 – Sony Europe B.V.

In general, we have similar views on supporting sidelink positioning, left-over from Rel-17, and positioning for RedCap UE (See also RWS-210301).

Q1: On positioning for RedCap UE: The current specification supports PRS over 20 MHz BW. Would you consider algorithm improvements as implementation aspect?

5 – InterDigital Communications

Could you elaborate on augmenting SL PRS in Uu PRS, i.e., how do you realize it and what is the benefit? For phase-based positioning, is enhancement for waveform needed (e.g., single-carrier based waveform)?

6 – Qualcomm Incorporated

Are the objectives I to IV ordered in priority from MTK's perspective? If not, is there a priority ordering from MTK with regards to these proposals (and the list that includes the rel-17 leftovers)

7 – Guangdong OPPO Mobile Telecom.

Question for clarification:

The current RAN-level SI for SL positioning covers only V2X and public safety use cases and requirements. Are you in favour for the subsequent WG-level WI includes / takes into consideration also commercial use cases and requirements?

8 – LG Electronics Inc.

Q1: How much bandwidth is needed for achieving phase based cm-level positioning accuracy?

9 – Intel Corporation (UK) Ltd

Q1: Can you clarify which method is supposed to be used for "cm-level positioning" and whether it requires any considerations in terms of LOS/NLOS propagation? Are there any requirements for NW side in terms of sync, etc.?"

Q2: How does augmenting Uu PRS with SL PRS work in e.g. out of coverage scenario? Do we assume standalone SL positioning operation in that scenario?

10 – Nokia France

What accuracy do you expect to achieve with 20MHz? Can you elaborate on what you mean by "PRS over 20MHz BW with algorithm improvements"?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 29:

Questions	Answers
CATT	Q1: Both solutions seem feasible. The implementation cost at UE side may further study. We also feel that sending the signal with narrowband, for example a sinusoidal signal, could be more flexible because it allows to transmit under different frequencies. So UE may also observe phase difference of different frequencies and the phase difference would correspond to the distance between a TRP and UE. Q2: We support SL positioning, and We also think carrier phase measurement is the technique for both SL positioning and the conventional positioning. Then the combination of SL positioning and carrier phase measurement, from our view, deserve to study further. Also need to know that, there could be more requirement and restriction on the signal phase and frequency offset for the transmission. By the way, we also think the measurement related to phase could be more generic. The phase could be related to different antennas, or different frequencies.
ZTE	Q1: Rel-17 doesn't actually achieve cm level accuracy. Rel-17 may enhance LOS/NLOS detection. So let's consider that if there are LOS for several links (TRPs to UE, or UEs to UE), then should we still rely on large BW? Our intention is to provide flexible solutions to NR positioning, and it doesn't always rely on large BW for accuracy. This is the reason we think the measurement related to signal phase could be studied deeply in Rel-18. Q2: If RS measurement BW is equal to data BW, and the BW is small, we may rely on algorithm enhancement, or the solution without relying on large BW for accuracy. It is also possible that RS measurement BW could be larger, and data BW is smaller. Rel-16 defines PRS is measured at MGs. Then it makes separate BW for data and for measurement feasible. We don't have answer for 5MHz bandwidth for positioning at this moment.
Xiaomi	We are open to consider unlicensed bands. However we would need to identify properly what would need to be changed compared to what we have today for licensed operation. In some regulations short infrequent control signals are allowed to be transmitted with no LBT today.

Sony	Yes, it could be related to RAN4 by defining advanced receiver for positioning having the capability of higher resolution algorithm. We think this is the bottom line for RedCap UE. We are also open for more aggressive solution for RedCap UE, such as the separate BW for data and for PRS measurement. Since Rel-16 positioning requires UE to measure PRS within MGs. Then the separate BW for data and for measurement could be feasible.
Interdigital	We should first study whether the existing PRS waveform can be re-used before considering significant changes. The received phase difference between 2 frequency points may be used to determine the distance. So, the spacing between 2 frequency points may determine the range without ambiguity.
Qualcomm	Yes, the order basically follows the priority. The Rel-17 leftover has equal priority to Objective IV.
Oppo	Yes, we have interest extending to the commercial use case, for example under IIOT, and the UE in moving may also be used as reference device, if the UE has certain confidence on its own location accuracy. Then this UE as reference device could also transmit PRS to other UEs to increase LOS links
LGE	The receiving phase difference between 2 transmission frequency points could determine the distance. For each frequency point, it could be treated as a single subcarrier. Of course, signal phase based measurement could be impacted by NLOS. Since Rel-17 there is enhancement for NLOS detection. Then it is also feasible that the location could be determined based on few LOS links (a link is between a TRP and UE) after ruling out NLOS links. We are also open to evaluate whether existing PRS/SRS could be enough for extracting phase, and even the phase difference.

Intel	Q1: It is a common solution to utilize larger transmission BW to gain the accuracy. If NLOS links could be ruled out, then do Intel still expect to use very large PRS BW? We also see the potential tougher requirement on network and UE side related to sync. The details need further study. Q2: Even if the UE is out of coverage from a cell suitability perspective, we believe that it could still receive PRS from a network via Uu on a best effort basis. In that case sidelink PRS could also be used as a source, so augmentation could be possible, but we do not believe there would necessarily be spec impact to allow this. Standalone sidelink we understand would not use Uu PRS by definition that the UE is only operating with sidelink.
Nokia	The conventional algorithm of observing CIR, could be worse in performance than the super resolution algorithm. If at the end, we only support same BW for data and for PRS measurement with limited BW, then the receiver enhancement could be required Or we can look for solution, for example, signal phase measurement which doesn't require large BW and the performance could be improved under LOS.

Please provide Round 2 questions below.

Feedback Form 43: Round 2 questions

1 – ZTE Corporation

What is your view to support integrity of RAT-dependent positioning methods in Rel-18?

2 – CATT

Thanks for MTK's responses to our questions.

About the "the use of measurement related to phase could be more generic. The phase could be related to different antennas, or different frequencies", yes, we fully agree that the carrier phase measurements for different antenna and/or different frequencies can be different, since the carrier phase measurements depends on both of the carrier frequency dependent and time dependent. Thus, for the reporting of the carrier phase measurements, there is a need to associate with the carrier frequency (f0+tthe subcarriers) and the antenna index if there are multiple antennas (e.g., DAS for SL-positioning).

Questions (Round 2):

For the self-calibration for group delay for accuracy enh, can MTK explain how it can be done, and whether it is performed dynamically? Also, R17 is working to the mitigation of the timing errors caused by the group delays. Should we consider the self-calibration of group delay in R17 instead of R18?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 30:

Questions	Answers
ZTE	We see some value in pursuing integrity for RAT-dependent positioning and would be OK with such an objective, but it would be important to be careful about the workload, especially in RAN1 where the error sources need to be determined. We assume this would be a study phase first.

CATT	UE may measure its own RX+TX group delay by sending known signal from DAC. The signal would go through RF coupler and then return from RX path to ADC. Then UE may observe the delay at ADC output. The signal to be sent could be a proprietary solution. Our ideas are that, if UE has RX+TX group delay self-calibration capability for each UE panel, then the RX group delay difference between a pair of panels, and TX group delay difference between a pair of panels, could be derived through some computation at LMF. The current solution candidate for UE RX group delay difference measurement is to measure same signal from a same TRP by 2 panels. We think this solution candidate has limitation of usage, because it may need to depend on probability that 2 panels of a UE are able to measure same signal from a same TRP. The different beam orientation between 2 panels basically makes such measurement difficult. We don't say it is absolutely impossible, but it may consume UE power to search a TRP signal which is able to be measured simultaneously by 2 panels of UE. If UE has capability for self-calibration for RX+TX group delay, then the RX group delay difference could be solved by receiving signal from different TRPs between 2 panels. We do believe that to receive signal from different TRPs between 2 panels would be easier than to receive same signal from same TRP between 2 panels. We also agree that, it is not all the UE has the capability of self-calibration. However, if some good UEs have such capability, it is reasonable to have easier approach to derive its own RX group delay difference, and its own TX group delay difference. We are proposing this in Rel-17 in RAN1. We think this is a good method and if unfortunately it is not agreed in Rel-17, we are thinking to consider it in Rel-18. Since CATT is the Rel-17 positioning rapporteur, and if CATT also thinks this is a nice solution, we appreciate support from CATT. We are really not comfortable by the current solution candidate heavily discussed in May meeting.

2.8.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: NR cm-level accuracy [RAN1, 2, 4]

- Transmission and measurement related to signal phase for determining angle and distance, without much wider signal bandwidth

Feedback Form 44: Questions

1 – ETRI

1) I agree with the objective I that measurement methods related to the signal phase should be introduced to achieve centimeter level accrual. Then, to what extent do you propose an appropriate bandwidth target for applying the phase-based method? Do you think this is more suitable for sidelink than macro or indoor?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 31:

Questions	**Answers**
ETRI	At least the phase difference between 2 frequency points could determine the distance. For each frequency point, it could be treated as a subcarrier. Then UE may need some more BW to design a filter to filter out signal so that the phase at each subcarrier could be extracted. We think the signal phase measurement is feasible for LOS condition. Macro, basically has low probability of LOS. We are positive to look at indoor and SL to realize signal phase measurement, even for ranging purpose

Please provide Round 2 questions below.

Feedback Form 45: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.8.3 Objective 2

Companies are kindly invited to provide their questions to the following objective:

Objective: Sidelink-assisted positioning [RAN1, 2, 4]

- Enable transmission of positioning assistance information from a reference UE to neighboring UEs using SL

- Augment Uu PRS with SL PRS

Feedback Form 46: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions:

To be filled in after Round II

2.8.4 Objective 3

Companies are kindly invited to provide their questions to the following objective:

Objective: Sidelink-based positioning [RAN1, 2, 4]

Feedback Form 47: Questions

1 – Beijing Xiaomi Mobile Software

-

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?

-

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)?

- Relative positioning: relative positioning is to estimate position relatively to other network elements or relatively to other UEs.
- Ranging: refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct communication connection.

MediaTek Inc. would like to provide the following answers to the above questions:

Table 32:

Questions	**Answers**
Xiaomi	Q1: We understand that SA1 have been at pains to distinguish ranging from positioning (see the SID in SP-200575) and the service aspects may be quite different. For example, the low latency requirements mean that ranging applications would probably need to avoid using the positioning server architecture. So we think the ranging requirements cannot be blindly ingested into a positioning work item. However, it looks like the underlying measurements would be related and we assume that work done under sidelink positioning would also benefit ranging. Q2: We understand these are different; positioning requires more information, and as noted above the service requirements can be different.

Please provide Round 2 questions below.

Feedback Form 48: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.8.5 Objective 4

Companies are kindly invited to provide their questions to the following objective:

Objective: RedCap support [RAN1, 4]

- PRS over 20MHz BW with algorithm improvements

Feedback Form 49: Questions

1 – Beijing Xiaomi Mobile Software
- Q1: Is there a need to define new accuracy requirement for RedCap positioning or just reuse the requirement defined for eMBB?
- Q2: Is there a need to have a short study phase to clarify the requirement for RedCap and perform the evaluation to see if there is gap to reach that requirement?
2 – Qualcomm Incorporated We are also supportive of RedCap Positioning, however we don't consider it only a topic of "algorithm improvements". Could you provide more information/clarification on this sub-bullet: "PRS over 20MHz BW with algorithm improvements". Are you considering both RAN1 and RAN4 enhancements, or only RAN4 enhancements?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 33:

Questions	**Answers**
Xiaomi	Q1: We are open to the case that, if the UE has advanced receiver for positioning capability, then the tougher requirement could be considered. Q2: We think it merits some study first.
Qualcomm	It is mainly for RAN4 enhancement. We are also open to have signal phase measurement for further study. The signal phase could be what Qualcomm proposes (related to phase difference between antenna), or phase difference between different frequency points. Of course, the impact of NLOS also needs to be considered

Please provide Round 2 questions below.

Feedback Form 50: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.9 RWS-210197 – Sub-band Full-duplex for gNB

2.9.1 Motivation

Companies are kindly invited to provide their questions to the following motivation:

Motivation: Interest in enabling gNB sub-band full-duplex operation is rising however careful study is required to:

- Identify the resource block partitioning scenarios i.e. namely where FD operates
- Identify the band / frequency range specific implications of such operation e.g. FR1 vs FR2
- Carefully study UE-UE interference aspects incl. guard bands, geo separation, UE ACS and UE ACLR
- Carefully study gNB-gNB interference aspects for intra-MNO and inter-MNO scenarios
- Carefully study impact to legacy UEs

Feedback Form 51: Questions

1 – Futurewei Technologies

FUTUREWEI considers that gNB flexible duplex and sub-band full duplex (and necessary interference hanlding schemes) is an interesting topic that deserves RAN1 attention and a very careful study. We agree that some of the objectives your contribution mention may be on the list of potential objectives to be studied along with some other objectives that need to be identified. We would like to know MKT view on the frequency bands and deployment scenarios that should have priority for such investigation. Please take a look at our contribution RWS-210036 (https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_AHs/2021_06_RAN_Rel18_WS/210036.zip) and feel free to comment at: https://nwm-trial.etsi.org/#/documents/4580

2 – Nokia Corporation

In our view it would be desirable to have prioritized study of gNB-2-gNB CLI in support of UL-heavy configs, and giving lower priority to FD cases. UE-2-UE CLI solutions was part of Rel-16 CLI, what kind of additional gains do you expect from further enhancements for UE-2-UE CLI? We share your view that for any flexible and full duplex studies legacy UE impacts should be considered.

3 – Intel Corporation (UK) Ltd

Q1. Given that basic feasibility of FD @ gNB needs to be determined by RAN4 as a first step, what is your view on managing the studies across RAN1 and RAN4? Specifically, under what assumptions should RAN1 proceed with for their study w/o information on isloation and self-, adjacent channel interference effects, etc. that would need RAN4 expertise?

MediaTek Inc. would like to provide the following answers to the above questions:

Table 34:

Questions	**Answers**
1 – Futurewei Technologies FUTUREWEI considers that gNB flexible duplex and sub-band full duplex (and necessary interference hanlding schemes) is an interesting topic that deserves RAN1 attention and a very careful study. We agree that some of the objectives your contribution mention may be on the list of potential objectives to be studied along with some other objectives that need to be identified. We would like to know MKT view on the frequency bands and deployment scenarios that should have priority for such investigation. Please take a look atourcontributionRWS-210036(https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSG_RAN_AH_s/2021_06_RAN1_Rel18_WS/TDocs_AHs/2021_06_RAN1_Rel18_WS/210036.zip) and feel free to comment at: https://nwm-trial.etsi.org/#/documents/4580	Thanks for the comments & questions. For flexible duplex or dynamic TDD, FR1 and dense urban deployment can be prioritized because of the following reasons. It's more difficult to achieve the self-interference mitigation target via spatial/frequency isolation UL coverage issue is less severe, compared to FR2, and Rel-17 coverage enhancement can already provide sufficient tools For sub-band full duplex, FR2 and urban macro and rural deployments should be prioritized because of the following reasons. It's more difficult to achieve the self-interference mitigation target via spatial/frequency isolation using massive antenna array Coverage issue is severe due to large inter-site distance gNB-2-gNB CLI issue is less severe due to large inter-site distance
2 – Nokia Corporation In our view it would be desirable to have prioritized study of gNB-2-gNB CLI in support of UL-heavy configs, and giving lower priority to FD cases. UE-2-UE CLI solutions was part of Rel-16 CLI, what kind of additional gains do you expect from further enhancements for UE-2-UE CLI? We share your view that for any flexible and full duplex studies legacy UE impacts should be considered.	Thanks for the comments & questions. In Rel-16 CLI, based our understanding, the UE-to-UE CLI mitigation is done via gNB scheduling avoidance, beamforming mitigation or UL power control according to UE measurement/report and SRS transmission. However, UE-to-UE CLI level varies dynamically so it's difficult to get additional gains unless additional information related to UE-to-UE CLI (e.g. statistical property for suppression or exact interference property for cancellation) can be provided to a UE. From our perspective, what kind of additional UE-to-UE CLI information is useful can be evaluated in the study. However, we also agree gNB-2-gNB CLI mitigation probably should be prioritized in the study.

3 – Intel Corporation (UK) Ltd Q1. Given that basic feasibility of FD @ gNB needs to be determined by RAN4 as a first step, what is your view on managing the studies across RAN1 and RAN4? Specifically, under what assumptions should RAN1 proceed with for their study w/o information on isloation and self-, adjacent channel interference effects, etc. that would need RAN4 expertise?	Thanks for the questions. We think RAN1 has to decide the scenarios for the study and identify potential RAN4 issues (e.g. isolation and self-, adjacent channel interference effects) for each scenario for RAN4 to study in the 1st meeting. Before RAN4 feedback, RAN1 can continue the discussion on evaluation methodology and candidate solutions for evaluation. After RAN4 feedback, RAN1 can perform system-level evaluation and conclude the study. Since it's a cross-WG study and lots of aspects (including RF, demod, system-level) need to be studied carefully, from our views, the study should span the whole Rel-18 time frame.

Please provide Round 2 questions below.

Feedback Form 52: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

2.9.2 Objective 1

Companies are kindly invited to provide their questions to the following objective:

Objective: Study sub-band full-duplex for gNB [RAN1, 2, 4]

- Identify RB partitioning scenarios i.e. where FD operates
- Identify band/FR specific implications e.g. FR1 vs FR2
- Study UE-UE interference aspects incl. e.g. guard bands, geo separation, UE ACS, UE ACLR
- Study gNB-gNB interference aspects intra/inter MNOs
- Study impact to legacy UEs

Feedback Form 53: Round 2 questions

MediaTek Inc. would like to provide the following answers to the above questions: No questions asked.

3 Summary of email discussion

The following summary is provided on the Q&A.

Sidelink Relay Enhancements:

MediaTek proposed to continue to enhance the NR sidelink relay concept including UE-to-UE L2 relay related support, topology extensions (multipath/hop), mobile node enhancements, and network coding for relay UE.

Regarding the proposals made, questions mainly focussed on understanding the next level of technical details of proposals, and differences between some scenarios, so further email discussion would help to further align understanding between companies.

Smart Repeater Enhancements

MediaTek proposed to extend the repeater concept to enable improved coverage and availability, transparent to end UE, and enabling interference mitigation via Tx power control.

Questions focussed on the different components required for the repeater and interactions between gNB and repeater.

Further email discussion would help to elaborate further some of those points and scope the work.

NTN/TN Spectrum Sharing

MediaTek proposed to study NTN/TN spectrum sharing to enable TN and NTN operators to make best use of available spectrum to maximise capacity for NTN and TN deployments.

Questions around scenarios, architecture, services used and some regulatory aspects.

It is recommended to cover further post-workshop email discussion in a broader NTN email discussion including other proposals.

AI/ML Integration

MediaTek proposed to study AI/ML integration into AS functions for decision quality and overhead reduction, and AI assistance to network functions. Some use cases were also proposed (RS overhead reduction, mobility prediction, and positioning enhancement, among others).

It was clarified that we expect AI/ML in the UE to be considered as part of AS functions integration, and is different from the RAN3 studies in that respect at least.

Questions were asked and answered on the specific use case proposals, and priorities – an aspect which clearly warrants broader discussion.

Further discussion would help to elaborate the scope and focus of studies.

AI/ML Traffic

MediaTek proposed to study AI/ML traffic and architecture for traffic management, and encoding mechanisms to reduce traffic transfer overheads.

It was clarified that "AI/ML traffic" means user plane traffic generated by AI/ML applications.

Questions were asked and answered on whether AI/ML traffic encoding is a RAN feature. Also it was questioned how any work on QoS parameters would be handled – which would clearly require SA2 support.

Further discussion would help to clarify the exact scope of studies for RAN for optimising AI/ML traffic transfer & management.

Mobility Enhancements

Questions focussed on L1/2 triggered CHO and beam-switching delay enhancement objectives, and on different detailed functional aspects within those.

Further discussion would be helpful to align on the detailed scope for this work, which would preferably be RAN2 led if this is progressed in Rel-18.

System Energy Enhancements

(CMCC, vivo, Apple, MTK proposed that both network and UE should be considered for R18 power saving enhancements. It was also highlighted that network capacity and user experience should not be sacrificed.

Dynamic power saving techniques, e.g., gNB/TRP/beam dormancy, are of certain interest for maximizing the power saving opportunity. UE dependency/support should be considered here.

Feedback indicated that a network side evaluation methodology is needed to identify the performance of enhancement techniques. The evaluation methodology in TR38.840 can be leveraged and extended.

One company believes that considering definition of energy saving modes in the standard may be useful.

Positioning Enhancements

MediaTek proposed enhancements to enable "cm-level" positioning accuracy, sidelink positioning, and RedCap positioning enhancements.

Questions on how to enable the cm-level accuracy via phase measurements and in which operating scenario. Other questions on the algorithm enhancement for RedCap UE positioning.

Some sidelink positioning questions were asked too.

In addition to further discussions, some evaluations would be needed to progress on technology choices for different aspects.

Sub-band Full-Duplex for gNB

MediaTek proposed to study sub-band full duplex operation at gNB-only (not at UE).

Question & answers provided related to usage of legacy CLI functionality, potential deployment scenarios, and also how the RAN1/4 work would be split.

Further email discussion would be useful to carefully scope the studies and identify the aspects on which to focus.