RAN-R18-WS-crossFunc-Samsung - Version 0.0.3
RAN

3GPP TSG RAN Rel-18 workshop RWS-210639

Electronic Meeting, June 28 - July 2, 2021

Agenda Item: 4.3

Source: Samsung

Title: Email discussion summary for [RAN-R18-WS-crossFunc-Samsung]

1 Introduction

This NWM document is intended to capture the comments and questions from interested companies on the proposals from Samsung for Cross-Functionalities in 5G-Advanced. According to the guideline from the RAN chair, the following timeline is to be followed.

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

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

Before June 25 18:00 UTC, email discussion summary is to be uploaded.

1.1 Related documents

This email discussion summary covers the following documents:

- RWS-210184 AS layer Security Enhancement for 5G Advanced

- RWS-210185 On the support of AI in PHY for 5G Advanced

- RWS-210187 Sidelink enhancement for 5G Advanced

- RWS-210188 Positioning enhancement for 5G Advanced

2 Technical items to be discussed

2.1 AS layer Security Enhancement in RWS-210184

The security is one of the essential parts of communication. However, the basic principles in AS security has not been changed much since LTE time, and it is time to review the current AS security and potential threats. Even though SA3 is already discussing the issues under their Rel-17 SI, they cannot make progress due to lack of time in Rel-17 timeframe and also the impact to RAN WGs. Hence, RAN should get prepared for the corresponding work in RAN side. That is, RAN can initiate Rel-18 SI in RAN to study the impact of the potential solutions discussing in SA3, as to aid SA3 in making conclusion.

Some topics can be studied:

- The impact of the potential solutions that provide integrity protection of L1 and/or L2 messages

- The impact of the potential solutions that provide integrity protection of the system information message

- The impact of the potential solutions that provide protection of the RRC messages (e.g. in INACTIVE state)

2.2 AI-PHY in RWS-210185

AI might be suitable to solve issues for which conventional solutions have either model deficit or algorithm deficit. AI can be used to relax conventional design requirements, reduce communication overhead, optimize link performance, and more.

Some interesting topics in AI-PHY:

- CSI processing

- Beam management

- Non-linearity handling

2.3 Sidelink enhancement in RWS-210187

Rel-18 NR sidelink should efficiently support new types of devices (such as AR glasses, Unmanned Aerial Vehicles, Very low power device, UE supporting Public safety and self-driving cars) which have been introduced in various industry. In this sense, the following enhancements could be considered.

- Sidelink operation over unlicensed spectrum (e.g., LBT)

- Sidelink carrier aggregation (not only for unlicensed spectrum assisted by licensed spectrum and but also for only licensed spectrum)

- Multi-beam operation for sidelink

- UE-to-UE relay

2.4 Positioning enhancement in RWS-210188

Positioning for public safety and mission critical communications requires both accurate location information and its availability, i.e., location information should be available in anytime/anywhere. Sidelink (SL) positioning can be a complementary solution when positioning based on GNSS and/or network is not available.

Some key topics for SL positioning:

- Design of SL positioning protocol

- Supported scenarios and positioning techniques for SL positioning

- SL PRS design and corresponding UE measurement

3 General comments (if any)

Please use section 3 to provide any general comments on the proposals from Samsung on Cross-Functionalities evolution for 5G-Advanced (AS security, AI-PHY, Sidelink enhancement and Positioning enhancement).

Feedback Form 1: General comments (if any)

4 Q&A on AS security (RWS-210184)

4.1 Round 1 Question

Feedback Form 2: QA on AS security (RWS-210184)

1 – Sony Europe B.V.

We, in general, support AS security enhancements and particularly integrity protection of L1/L2 signaling. We have a paper in RWS-210379. Do you propose a parallel study or staggered in time between SA3 and RAN?

4.2 Round 1 Answer

1. Answers to Sony

We, in general, support AS security enhancements and particularly integrity protection of L1/L2 signaling. We have a paper in RWS-210379. Do you propose a parallel study or staggered in time between SA3 and RAN?

Answer: thank you for your comment, and we also think that to extend integrity protection to L2 (or even L1) can be one of the objectives for this area.

Regarding your question, we think it depends on the SA3 input, but most likely the staggered approach would be applied given the situation in SA3. That is, SA3 is still discussing the scope of the Rel-17 (not

18) WI FBS, and actual work for Rel-18 in RAN can be started only after having the explicit input from SA3, as whether to introduce such an enhancement (among many potential solutions from their TR) can be justified by SA3 only. So, in short, if RAN can get input from SA3 before Rel-18 (e.g. this December), we can work in parallel but otherwise we should go with staggered approach.

4.3 Round 2 Question

Feedback Form 3: 2nd round QA on AS security (RWS-210184)

1 – Xiaomi Communications

We are supportive to the study of the AS security enhancements in general. Here we have the following questions for clarification:

Question1: Is SA3 currently having any discussion/study on the security issues related to the L1/L2 signaling in AS?

Question 2: Do you think both Uu and PC5 need to be considered for the AS security enhancement?

4.4 Round 2 Answer

1. Answers to Xiaomi

We are supportive to the study of the AS security enhancements in general. Here we have the following questions for clarification:

Question1: Is SA3 currently having any discussion/study on the security issues related to the L1/L2 signaling in AS?

Answer: thanks for your support. As captured in their TR 33.809, SA3 has identified the issue on L1/L2 signaling (e.g. header, MAC CE, etc.) as Key Issue #7 (i.e. Protection against Man-in-the-Middle false gNB attacks), and only one candidate solution (i.e. Solution #23) is listed to mitigate the threat so far (i.e. limited progress only).

Question 2: Do you think both Uu and PC5 need to be considered for the AS security enhancement?

Answer: we are open to discuss, but from our understanding, PC5 interface is already protected, so are wondering which part should be further protected for PC5 (also asked the question to Xiaomi's paper).

5 Q&A on AI-PHY (RWS-210185)

5.1 Round 1 Question

Feedback Form 4: QA on AI-PHY (RWS-210185)

1 – Intel Technology India Pvt Ltd

(1) What is Samsung's view on AI model management in Rel-18 while keeping AI as a black box and implementation specific?

(2) Is study of NN structures, weights etc. in scope?

(3) Regarding slide 6 (non-linearity handling): Which PHY blocks are suggested to be replaced by ML block at the Tx and Rx sides? And what is the achievable EVM or post-processing EVM for the provided illustration?

2 – LG Electronics France

Q. Do you assume that the study only needs to involve RAN1 or do you assume that other working groups also need to be involved to discuss "how to collect data-sources for online training, which may impact RS design, measurement, feedback/report. new signaling/control procedure to leverage AI, incl. device capability indication, and AI model management (for offline trained models) etc."

3 – CATT

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

Q1: On page 4, regarding the CSI compression use case, what is the training procedure? Is it online training, offline training or else?

Q2: On page 5, what is the conventional beam prediction algorithm? What is the AI algorithm used in the evaluation?

Q3: On page 6, AI powered nonlinearity handling seems to be a pure receiver implementation choice. What is the expected specification impact?

4 – Sony Corporation

Thanks for the contribution. We have two questions.

- AI encoder and decoder
  - How are the AI neural encoder and decoder trained. For example, network provides some data set for training, or trained AI model is downloaded to the UE?
- RSRP dataset generation and training of the dataset
  - Who does generate the RSRP dataset and who will train AI model with the RSRP dataset?

5 – CAICT

Thanks for the good contribution. CSI prediction and CSI estimation is proposed in Page 4. What's your views on AI based channel estimation with pilot?

6 – DOCOMO Communications Lab.

Thank you for the contribution.

We have some questions regarding the PA non-linearity enhancement.

1) Do you think it is possible to apply offline training for different PA and different frequency bands to get rid of the onling training session since the online training is resource-consuming?

2) Guess your simulation results are based on the output of DPD, so do you think the AI can completely replace the DPD or the DPD function can be simplified if the AI's performance is good enough in the future?

Thanks!

7 – Apple Hungary Kft.

"how to collect data-sources for online training, which may impact RS design, measurement, feedback/report etc." Can you elaborate which use cases in the slide are trained using online training?

8 – Qualcomm Incorporated

1. Is the study focus on high order modulations?
2. Is the study focus and proposal for DL, UL, or both?
3. How should 3gpp study this? In particular, what dataset, PA models (synthetic or measurement), or study assumptions do we need?
4. On the simulation results:

a. Are they with Rx-only AI or joint Tx-Rx AI?
b. What is the PA model assumed?

9 – MediaTek Inc.

Thanks for the contribution. Some questions for clarification:

1) What are the prioritized use cases to be studied?

2) Does Samsung think it is useful to establish the "test data set" (repository)?

10 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you very much for the contribution.

Q1: For different TX/RX pairs or different transmit power, the non-linear effects can be different, how to deal with this?

11 – Nokia Corporation

Have you considered how to ensure predictable UE behaviour with AI/ML in UE and how to ensure that UE always meets its minimum requirements with AI/ML and UE performance is enhanced in the proposed AI/ML use cases?

5.2 Round 1 Answer

1. Answers to Intel

(1) What is Samsung's view on AI model management in Rel-18 while keeping AI as a black box and implementation specific?

Answer: AI model/algorithm is generally problem-specific and scenario-specific. Whether there is a need of specifying AI model management could be discussed per the specific issue to be handled by AI. It is preferred to make candidate AI models spec-transparent, but a signaling of necessary parameters to facilitate AI model selection/management could be considered.

(2) Is study of NN structures, weights etc. in scope?

Answer: do not see strong/clear need to include the study of specific NN structure, weights etc. in the scope for now. However, discussing a general norm for NN structure for the evaluation purpose would be necessary.

(3) Regarding slide 6 (non-linearity handling): Which PHY blocks are suggested to be replaced by ML block at the Tx and Rx sides? And what is the achievable EVM or post-processing EVM for the provided illustration?

Answer: the proposed AI functionality is to be embedded in the conventional PHY equalization block at RX side only. For the illustration in slide#6, the EVM is improved from 3.5% to about 1.1% after AI post-processing at RX assuming AWGN and a Rapp PA model.

2. Answers to LGE

Q. Do you assume that the study only needs to involve RAN1 or do you assume that other working groups also need to be involved to discuss "how to collect data-sources for online training, which may impact RS design, measurement, feedback/report. new signaling/control procedure to leverage AI, incl. device capability indication, and AI model management (for offline trained models) etc."

Answer: For the statement that you referred to, those aspects would be mainly discussed in RAN1. Whether other WGs need to be involved depends on the specific issues in the final scope of AI study item.

3. Answers to CATT

Q1: On page 4, regarding the CSI compression use case, what is the training procedure? Is it online training, offline training or else?

Answer: Currently we trained the model offline with simulation data or measured data. Offline pre-training + online finetuning may be a choice for auto-encoder neural network.

Q2: On page 5, what is the conventinal beam prediction algorithm? What is the AI algorithm used in the evaluation?

Answer: it is one of our previous tests and the conventional algorithm is exhaustive searching among 16 beams while Q-learning AI algorithm is used to predict beam by measuring selected 4 beams. Our goal is to reduce the measurement occasions to perform the beam prediction/selection.

Q3: On page 6, AI powered nonlinearity handling seems to be a pure receiver implementation choice. What is the expected specification impact?

Answer: the expected spec impact could be e.g. the capability indication to leverage the proposed AI powered nonlinear equalization such that PA power reduction could be relaxed to improve the coverage or higher MCS could be scheduled for a given BLER operation requirement.

4. Answers to Sony

AI encoder and decoder

How are the AI neural encoder and decoder trained. For example, network provides some data set for training, or trained AI model is downloaded to the UE?

Answer: Currently we trained the model offline with simulation data generated by a channel model in TR 38.901 and the pre-training is based on RS. The trained AI model could be downloaded to the UE.

RSRP dataset generation and training of the dataset

Who does generate the RSRP dataset and who will train AI model with the RSRP dataset?

Answer: We consider the case in which UE generate (measure) RSRP data and training is conducted in NW side based on the reported RSRP data.

5. Answers to CAICT

CSI prediction and CSI estimation is proposed in Page 4. What's your views on AI based channel estimation with pilot?

Answer: Channel estimation for demodulation requires real-time processing, and wireless channel are time-varying and deployment scenario dependent, we think it is quite challenging to use AI for that purpose. Offline trained model may have generalization issue while online training may not be timely. On the other hand, current channel estimation schemes work well and we do not see a strong motivation or pain point for now.

6. Answers to DoCoMo

1) Do you think it is possible to apply offline training for different PA and different frequency bands to get rid of the onling training session since the online training is resource-consuming?

Answer: for the proposed AI powered non-linearity handling, we do not think the online training is resource-consuming. We consider same RS overhead to support online-training as NR and real-time online training is viable based on our tests. Actually offline training is more challenging as different devices may have different PA properties, and PA property is temperature-varying, e.g. gNB has not idea about UE's PA property and it is not viable to train the PA for each UE.

2) Guess your simulation results are based on the output of DPD, so do you think the AI can completely replace the DPD or the DPD function can be simplified if the AI's performance is good enough in the future?

Answer: our proposal can compensate the non-linearity at RX side regardless of whether DPD is functioned or not at TX side, but the motivation to use AI is stronger if DPD is not viable due to implementation cost, e.g., no DPD at UE TX. We think it is possible to avoid costly DPD or relaxed the requirement of DPD in the future with the proposed AI function. We tested this function with both of real data from hardware and simulation data from a PA model assuming no DPD, but the illustrative result shown in our slides is based on a simulation data from a PA model.

7. Answers to Apple

"how to collect data-sources for online training, which may impact RS design, measurement, feedback/report

etc." Can you elaborate which use cases in the slide are trained using online training?

Answer: We propose online training mainly for the use case of AI based non-linearity handling at this moment. Pls check our response to DoCoMo's questions for more details.

For other use cases, we are open to study the need to support online training for refinement while we only study offline training for now.

8. Answers to Qualcomm

1. Is the study focus on high order modulations?

Answer: yes, the motivation is stronger in the case of higher order modulations.

2. Is the study focus and proposal for DL, UL, or both?

Answer: even though we are mainly consider it for UL for now (i.e. to be functioned at gNB side), but we are open to extend it for both of UL and DL.

3. How should 3gpp study this? In particular, what dataset, PA models (synthetic or measurement), or study assumptions do we need?

Answer: we can use the sophisticated PA models in 3GPP TR 38.803 for dataset generation and NR DMRS for online training as starting point for the feasibility study. The metric for such study could be RX EVM improvement for a given TX EVM or power back-off relaxation (i.e. TX EVM relaxation) for a given BLER operation requirement. We are open to discuss other methodologies.

4. On the simulation results:

a. Are they with Rx-only AI or joint Tx-Rx AI?

Answer: with RX-only AI.

b. What is the PA model assumed?

Answer: Rapp model was assumed for the provided illustrative result. We also evaluated it with GMP model and real data from hardware, and observed similar potential.

9. Answers to MediaTek

1) What are the prioritized use cases to be studied?

Answer: we see the potential of AI for all the selected use cases in our slides and hope all could be included in the study scope.

2) Does Samsung think it is useful to establish the "test data set" (repository)?

Answer: if group could consensus on "common test dataset", we think it is useful for the evaluation and draw the observations/conclusions.

10. Answers to Huawei

Q1: For different TX/RX pairs or different transmit power, the non-linear effects can be different, how to deal with this?

Answer: The AI powered non-linearity handling is to use online training based on real-time received RS samples, such that timely update for the changing of non-linear effect is enabled.

11. Answers to Nokia

Have you considered how to ensure predictable UE behaviour with AI/ML in UE and how to ensure that UE always meets its minimum requirements with AI/ML and UE performance is enhanced in the proposed AI/ML use cases?

Answer:

We think such problem and question can be resolved together with study in physical-layer. Since this study has not been done for practical use cases in physical-layer, many questions including these can be studied in long-term.

5.3 Round 2 Question

Feedback Form 5: 2nd round QA on AI-PHY (RWS-210185)

1 – ZTE Corporation On "Non-linearity handling in PA", what potential specification impact you have in mind is for this AI based DPD? Perhaps mostly in RAN4?
2 – ZTE Corporation On Page 5, based on your reply to other companies, 'the conventional algorithm is exhaustive searching among 16 beams while Q-learning AI algorithm is used to predict beam by measuring selected 4 beams'. If our understanding is correct, the conventional algorithm by exhaustive searching should be optimal in terms of best beam determination and RSRP , but with huge RS overhead, right? But, based on your results, we are wondering why the conventional approach can NOT reach the upper bound but also is inferior to the predictable approach?
3 – NTT DOCOMO INC. Thanks for the contribution. We share the same view that AI-powered beam management should be an important use case to be studied. We have several questions regarding this use case (page 5), - What is the assumption of "past (limited) beam reporting"? Does Samsung assume the UE measure the fixed subset of beams and report periodically?

- Does conventional and AI algorithm perform beam prediction based on same assumption of beam measurement/report?
- How to understand the simulation result of “Ratio of # of CSI-RS per cycle”? Is that reflect the signaling overhead?
- What is the potential spec impact for this use case? Thanks!
4 – vivo Mobile Communication Co. Thanks for sharing your views and evaluation results. One question regarding Rx side only PA non-linearity, do you think OOBE might need to be additionally handled for the case transmitting with less power reduction?

5.4 Round 2 Answer

1. Answers to ZTE

On “Non-linearity handling in PA”, what potential specification impact you have in mind is for this AI based DPD? Perhaps mostly in RAN4?

Answer: the expected spec impact could be e.g. the capability indication to leverage the proposed AI powered nonlinear equalization such that PA power reduction could be relaxed to improve the coverage and power efficiency or higher MCS could be scheduled for a given BLER operation requirement from signaling aspect. RAN4 would study if there is a need to specify relaxed requirements for the maximum power reduction (MPR) and EVM for higher order modulation by AI enabled non-linear equalization.

2. Answers to ZTE

On Page 5, based on your reply to other companies, ’the conventional algorithm is exhaustive searching among 16 beams while Q-learning AI algorithm is used to predict beam by measuring selected 4 beams’. If our understanding is correct, the conventional algorithm by exhaustive searching should be optimal in terms of best beam determination and RSRP , but with huge RS overhead, right? But, based on your results, we are wondering why the conventional approach can NOT reach the upper bound but also is inferior to the predictable approach?

Answer: for conventional method, UE switches its beam after searching all beams at the time slot of the measurements, but it may not be optimal after the measurement time-point in a dynamic channel situation. However, the merit of AI method is its ability to predict “future optimal beam”.

3. Answers to NTT DOCOMO

We share the same view that AI-powered beam management should be an important use case to be studied.

We have several questions regarding this use case (page 5),

- What is the assumption of “past (limited) beam reporting”? Does Samsung assume the UE measure the fixed subset of beams and report periodically?

Answer: yes, “UE measure the fixed subset of beams” is based on measurement on a fixed subset of beams, used for performance comparison.

- Does conventional and AI algorithm perform beam prediction based on same assumption of beam measurement/report?

Answer: for the AI algorithm UE measures 4 beams only and for conventional method UE measures all 16 beams for beam selection. Except that, other respects are the same for a fair comparison.

- How to understand the simulation result of “Ratio of # of CSI-RS per cycle”? Is that reflect the signaling overhead?

Answer: yes. More beams to be measured means more signaling overhead for beam management. The results shows that AI algorithm only take 25% overhead to achieve a comparable performance of beam management.

- What is the potential spec impact for this use case?

Answer: it could have impact on CSI reporting, which could be different as the input of AI network.

4. Answers to vivo

One question regarding Rx side only PA non-linearity, do you think OOBE might need to be additionally handled for the case transmitting with less power reduction?

Answer: current OOBE requirements in RAN4 should be fulfilled anyway, even if PA power back-off could be relaxed for the purpose of improving coverage and PA efficiency by an amount due to EVM improvement based on AI powered non-linear equalization at RX side.

Answer: current OOBE requirements in RAN4 should be fulfilled anyway, even if PA power back-off could be relaxed for the purpose of improving coverage and PA efficiency by an amount due to EVM improvement based on AI powered non-linear equalization at RX side.

On the other hand, if we do not relax PA power back-off, i.e. keep target TX EVM and ACLR same, the AI powered non-linearity is to improve the BLER performance of higher order modulation at high SNR range.

6 Q&A on Sidelink enhancement (RWS-210187)

6.1 Round 1 Question

Feedback Form 6: QA on Sidelink enhancement (RWS-210187)

1 – LG Electronics Inc. Q1: Is it your proposal to support only the licensed-assisted approach in Rel-18? In that case, a Rel-18 UE supporting SL on unlicensed band shall support SL CA, one carrier in licensed band and another carrier in unlicensed band?
2 – HuaWei Technologies Co. Q1: regarding support of license-assisted approach to keep backward compatibility with Rel 16/17 sidelink UEs for sidelink CA, does this mean to apply CA in mode 1 only? Q2: regarding SL relay, We also think single hop should be prioritized to control the work load, do you think single hop is prioritized for both U2U and U2N relay?
3 – Qualcomm Incorporated 1. For unlicensed band operation, is this for <7GHz only, or does it include 60GHz? 2. For licensed band operation, are you intending to support only FR2, or higher bands as well?
4 – CATT Do you consider unlicensed sidelink as a separate WI or do you want to have this topic combined with other sidelink enhancements?
5 – MediaTek Inc. Thanks for the contribution. For clarification, do you target unlicensed sidelink in FR1/FR2/both?

6.2 Round 1 Answer

1. Answers to LGE

Q1: Is it your proposal to support only the licensed-assisted approach in Rel-18? In that case, a Rel-18 UE supporting SL on unlicensed band shall support SL CA, one carrier in licensed band and another carrier in unlicensed band?

Answer: yes, your understanding is correct. We consider this to be a step towards incremental development of sidelink over unlicensed while reducing the workload, similar to what LAA did. On the other hand, we are open to support SL CA in licensed band and ITS band for SL throughput enhancement.

2. Answers to Huawei

Q1: regarding support of license-assisted approach to keep backward compatibility with Rel 16/17 sidelink UEs for sidelink CA, does this mean to apply CA in mode 1 only?

Answer: we think that licensed-assisted approach can be applicable for both mode 1 and mode 2.

Q2: regarding SL relay, We also think single hop should be prioritized to control the work load, do you think single hop is prioritized for both U2U and U2N relay?

Answer: as single hop is prioritized for U2N relay in R17 WI, we'd like to want to stick on the single-hop prioritization for U2N relay and no further work for multi-hop U2N relay in R18. We prefer to work on further enhancement to allow multi-hop for both U2N and U2U in later release.

3. Answers to Qualcomm

1. For unlicensed band operation, is this for <7GHz only, or does it include 60GHz?

Answer: < 7GHz is our first preference in order to make scope of Rel-18 SL manageable. Whether or not to consider 60GHz in Rel-18 SL will be depending on what other features will be supported together.

2. For licensed band operation, are you intending to support only FR2, or higher bands as well?

Answer: similar to Q1, whether or not to consider FR2 licensed band in Rel-18 SL will be dependent on what other features will be supported together.

4. Answers to CATT

Do you consider unlicensed sidelink as a separate WI or do you want to have this topic combined with other sidelink enhancements?

Answer: we are not sure you exact intention about this question but our preference is that unlicensed operation should be discussed together with other SL enhancement features such as SL CA, SL beam management and so on in Rel-18 SL WI. On the other hand, SL positioning and RedCap positioning using SL should be discussed in other WIs, e.g., positioning enhancement and RedCap enhancement, respectively.

5. Answers to MediaTek

For clarification, do you target unlicensed sidelink in FR1/FR2/both?

Answer: FR1 is our first preference in order to make scope of Rel-18 SL manageable. Whether or not to consider 60GHz in Rel-18 SL will be depending on what other features will be supported together.

6.3 Round 2 Question

Feedback Form 7: 2nd round QA on Sidelink enhancement (RWS-210187)

1 – LG Electronics Inc.

Q1: As a follow-up of our question on the licensed-assisted SL operations, can you illustrate what kind of signaling/assistance will be sent via the licensed carrier and how it can reduce the work load?

6.4 Round 2 Answer

1. Answers to LGE

Q1: As a follow-up of our question on the licensed-assisted SL operations, can you illustrate what kind of

signaling/assistance will be sent via the licensed carrier and how it can reduce the work load?

Answer: this is similar to LAA for LTE and NR. The unlicensed carrier supports SL data transmissions. Some control (e.g. PSFCH) and synchronization information are transmitted in the licensed carrier. This reduces work load by not supporting SL-Sync and some SL control in the unlicensed spectrum.

7 Q&A on Positioning enhancement (RWS-210188)

7.1 Round 1 Question

Feedback Form 8: QA on Positioning enhancement (RWS-210188)

1 – CATT

We share the similar view that SL positioning can be a standalone positioning solution or a complementary solution of other GNSS and/or network.

2 – Intel Technology India Pvt Ltd

Can you clarify motivation behind the following statement: ”Whether to introduce a new type of device designated for sidelink positioning”? Is that about RSU or positioning reference unit, etc.? Or, something different from a typical UE? (or just introduction of new UE capability to support the SL based positioning?)

3 – 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.
- Q3: Do you think unlicensed band should be considered? If so, what frequency range is considered (e.g. 60GHz)?

-

Q4: Do you think power consumption and Redcap UE should be taken into account?

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Q5: In page 4, it noted that 'Whether to introduce a new type of device designated for sidelink positioning'. For this point, We think at least the new UE capability should be introduced for sidelink positioning, but we are not sure whether a new UE type is needed, could you please provide more explanations for introducing a new UE type for sidelink positioning?

4 – Sony Europe B.V.

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

Q1) Would Samsung only consider sidelink positioning as the Positioning topic in Rel-18?

Q2) What do you mean with new device type for sidelink positioning. Is it some kind of RSU-like device, with the only purpose for sidelink positioning?

5 – Qualcomm Incorporated

How is a "new type of device designated for SL positioning" different from other UEs, and what are the sepcific requirements for it?

6 – Huawei Tech.(UK) Co.. Ltd

High LOS probability is not guaranteed, it is related to the scenario and selected user. How is the NLOS UE-to-UE link dealt with? Is the NLOS identification required implicitly here?

7 – Lenovo (Beijing) Ltd

Q1: For your mentioned use cases, whether the public safety/V2X scenario and UAV scenario should be considered together for the sidelink positioning design or take UAV scenario as a separate case and include it in another topic, e.g. UAV, considering NR UAV is not supported in current release.

Q2: Share the concern with above companies, for your clarified scenario, what's the new type of device for sidelink positioning mean? Some new UE capability will be considered to support SL positioning?

Q3: Do you consider SL positioning as part of NR positioning specific SI, or within the scope of sidelink SI?

7.2 Round 1 Answer

1. Answers to CATT

We share the similar view that SL positioning can be a standalone positioning solution or a complementary solution of other GNSS and/or network.

Answer: thanks for sharing your view.

2. Answers to Intel

Can you clarify motivation behind the following statement: "Whether to introduce a new type of device designated for sidelink positioning"? Is that about RSU or positioning reference unit, etc.? Or, something different from a typical UE? (or just introduction of new UE capability to support the SL based positioning?)

Answer: Our intention on "a new type of device" was the following: 1) whether or not RSU or anchor UE (positioning reference unit) will be included, 2) If yes, then whether or not such a device will be different from a typical sidelink device.

3. Answers to Xiaomi

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?

Answer: this is under discussion in [92-e-07-SL-Positioning-TR]. Since SID describes "Identify the positioning use cases and requirements for V2X and public safety, based on the existing 3GPP work and input from industry fora.", we think that only existing requirements need to take into account. In other words, we do not need to consider new or updated requirements in TR22.855/TS22.261.

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.

Answer: as far as we understood, if ranging is defined as the determination of the distance between UEs AND the direction of one UE from the other one, then ranging and relative positioning are the same. Otherwise, they can be different. However, the difference just comes from whether both distance and direction are provided or either of them is provided.

Q3: Do you think unlicensed band should be considered? If so, what frequency range is considered (e.g. 60GHz)?

Answer: we think that at first sidelink communication over unlicensed band needs to be studied. For example, SL PRS (if supported) design should be relied on SL frame structure operating in unlicensed band. Regarding the question about 60 GHz, the same applies, i.e., sidelink communication over unlicensed band in 60 GHz needs to be studied first.

Q4: Do you think power consumption and Redcap UE should be taken into account?

Answer: we think that low power positioning would be beneficial. However, whether to take into account low power positioning or not in Rel-18 positioning will depend on the exact work scope, which will be discussed later

Q5: In page 4, it noted that 'Whether to introduce a new type of device designated for sidelink positioning'. For this point, We think at least the new UE capability should be introduced for sidelink positioning, but we are not sure whether a new UE type is needed, could you please provide more explanations for introducing a new UE type for sidelink positioning?

Answer: our intention on "a new type of device" was the following: 1) whether or not RSU or anchor

UE (positioning reference unit) will be included, 2) If yes, then whether or not such a device will be different from a typical sidelink device. As you said, new UE capability can be introduced.

4. Answers to Sony

Q1) Would Samsung only consider sidelink positioning as the Positioning topic in Rel-18?

Answer: we are open to include other positioning topics (e.g., left over in Rel-17 ePos) if it is justified and manageable within Rel-18 timeline.

Q2) What do you mean with new device type for sidelink positioning. Is it some kind of RSU-like device, with the only purpose for sidelink positioning?

Answer: our intention on "a new type of device" was the following: 1) whether or not RSU or anchor UE (positioning reference unit) will be included, 2) If yes, then whether or not such a device will be different from a typical sidelink device. So, yes, that can be RSU-like device.

5. Answers to Qualcomm

How is a "new type of device designated for SL positioning" different from other UEs, and what are the sepcific requirements for it?

Answer: our intention on "a new type of device" was the following: 1) whether or not RSU or anchor UE (positioning reference unit) will be included, 2) If yes, then whether or not such a device will be different from a typical sidelink device. On specific requirements, we think that this UE needs be selected carefully to obtain accurate positioning of target UE.

6. Answers to Huawei

High LOS probability is not guaranteed, it is related to the scenario and selected user. How is the NLOS UE-to-UE link dealt with? Is the NLOS identification required implicitly here?

Answer: yes, since LOS/NLOS/multipath identification and mitigation are now studying Rel-17 ePos, we think that this will be able to be extended also for sidelink positioning.

7. Answers to Lenovo

Q1: For your mentioned use cases, whether the public safety/V2X scenario and UAV scenario should be considered together for the sidelink positioning design or take UAV scenario as a separate case and include it in another topic, e.g. UAV, considering NR UAV is not supported in current release.

Answer: yes, UAV scenario can be separated from sidelink positioning since it was not included in Rel-18 SL positioning SI.

Q2: Share the concern with above companies, for your clarified scenario, what's the new type of device for sidelink positioning mean? Some new UE capability will be considered to support SL positioning?

Answer: our intention on "a new type of device" was the following: 1) whether or not RSU or anchor UE (positioning reference unit) will be included, 2) If yes, then whether or not such a device will be different from a typical sidelink device. As you said, new UE capability can be introduced.

Q3: Do you consider SL positioning as part of NR positioning specific SI, or within the scope of sidelink SI?

Answer: currently, we prefer to include SL positioning as a part of NR positioning specific SI since we think that this would be the best to make work scope manageable.

7.3 Round 2 Question

Feedback Form 9: 2nd round QA on Positioning enhancement (RWS-210188)

1 – Intel Corporation (UK) Ltd Q1: Do you also consider NR Uu positioning support in unlicensed spectrum?
2 – Beijing Xiaomi Mobile Software Thanks for your response. Regarding a new type of device for sidelink positioning, what is the difference between anchor UE (positioning reference unit) and normal UE in your mind, can normal UE also be anchor UE?

7.4 Round 2 Answer

1. Answers to Intel

Q1: Do you also consider NR Uu positioning support in unlicensed spectrum?

Answer: currently, we prefer to extend accuracy improvements specified for DL, UL, or DL + UL in Rel-17 positioning enhancements to include sidelink at first. We are open to include other positioning enhancements such as supporting unlicensed spectrum if work scope is manageable.

2. Answers to Xiaomi

Regarding a new type of device for sidelink positioning, what is the difference between anchor UE (positioning reference unit) and normal UE in your mind, can normal UE also be anchor UE?

Answer: the anchor UE may provide it's location to other UE(s) for UE-based positioning. The anchor UE may transmit or receive sidelink PRS. The anchor UE may forward positioning measurements from a target UE into location server. In addition, the anchor UE may provide sidelink positioning configuration to the target UE. Therefore, we think that the anchor UE is a kind of positioning capable UE rather than normal UE. Also, the role of the anchor UE can be different depending on positioning schemes supported in sidelink.

8 Summary

8.1 AS security (RWS-210184)

1 company participated in the 1st round discussion for AS security and 1 company participated in the 2nd round discussion.

- There is support from the companies to proceed the study item for the issue in Rel-18.

- The actual schedule (e.g. when to start) and the scope of the study item can be determined based on the input from SA3 feedback, hopefully by the end of this year.

8.2 AI-PHY (RWS-210185)

11 companies participated in the 1st round discussion for AI-PHY and 3 companies participated in the 2nd round discussion.

- 6 companies asked about general questions including AI modeling, how to collect data-sources for training. For AI model/algorithm, we think that it is generally problem-specific and scenario-specific and also preferred to make candidate AI models spec-transparent, but a signaling of necessary parameters to facilitate AI model selection/management could be considered. For data set, if group could consensus on “common test dataset”, we think it is useful for the evaluation and draw the observations/conclusions.

- 7 companies asked questions on details of particular use cases, where 6 companies showed interested on non-linearity handling. We also receive some interests on CSI and beam management for using AI.

Based on the discussions, TSG-RAN needs to have further discussion on the evaluation methodology including whether/how to collect data-sources for training, and try to identify some potential use cases, including at least non-linearity handling, CSI feedback, and beam management.

8.3 Sidelink enhancement (RWS-210187)

5 companies participated in the 1st round discussion for Sidelink enhancement and 1 company participated in the 2nd round discussion.

- 2 companies asked about the operation/scope of license-assisted approach in the 1st round, we replied that it can include mode 1 and 2 scheduling, and CA can be considered for supporting this approach.

- 2 companies asked about band for unlicensed operation in the 1st round, we replied that FR 1 (e.g., < 7GHz) is our first preference, and FR 2 (e.g., 60GHz) can be further discussed according to the final work scope.

- 1 company asked about prioritization of single-hop for SL relay in the 1st round, we replied that single-hop is prioritized for Rel-18 and multiple-hop would be considered in later release.

- 1 company asked about band for licensed operation in the 1st round, we replied that FR 1 is our first preference, and FR 2 can be further discussed according to final work scope.

- 1 company asked about WI scope in the 1st round, we replied that general sidelink scope should include unlicensed operation, SL CA and MIMO enhancement. On the other hand, SL positioning and RedCap positioning using SL should be discussed in other WIs.

- 1 company asked about detailed operation of licensed-assisted approach in the 2nd round, we replied that some of sidelink physical channel/signal can be transmitted over licensed band that can reduce work scope.

8.4 Positioning enhancement (RWS-210188)

7 companies participated in the 1st round discussion for Positioning enhancement and 2 companies participated in the 2nd round discussion.

- 5 companies asked about the new type of device designated for sidelink positioning in the 1st round, we replied that it is like RSU or anchor UE and such device can be different from a typical sidelink device. 1 company asked about the difference between anchor UE and typical UE in the 2nd round, we replied with specific examples that compared to typical UE, anchor UE can have/require more functionalities for sidelink positioning.

- 1 company asked about difference between relative positioning and ranging in the in the 1st round, we replied that it depends on whether relative positioning includes both distance and direction or either of them.

- 1 company asked about LOS/NLOS identification in sidelink in the in the 1st round, we replied that it can be extended in sidelink since it is now studying in Rel-17 ePos.

- 1 company asked about whether sidlink positioning is within sidelink work item or positioning work item in the 1st round, we replied that it is preferred within positioning work item since it would be the best way to make work scope manageable.

- 3 companies asked about the work scope of Rel-18 positioning. Whether or not to support low power positioning (for Redcap UE) and positioning support in unlicensed spectrum both in the 1st and the 2nd rounds, we replied that it can be further discussed according to the final work scope.