RAN-R18-WS-non-eMBB-Xiaomi - Version 0.0.3
RAN

NWM Document Name:- ***RAN-R18-WS-non-eMBB-Xiaomi***

3GPP TSG-RAN Rel-18 Workshop RWS-210604

Electronic Meeting, June 28 - July 2, 2021

Agenda item: 4.2

Source: Xiaomi

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

Document for: Discussion

1 General Comments

This email discussion provides details regarding Xiaomi's proposals for non-eMBB enhancements proposed for adoption by 3GPP RAN for REL-18. In accordance with direction provided by the RAN chair this email is intended to run from 14 June to 24 June and serves the purpose to help with companies understanding of the proposals ahead of the RAN REL-18 Workshop, June 28th – July 2nd 2021.

This email discussion summary covers the following documents:

RWS-210088 Car communication via 5G NR

RWS-210089 Work Item on Car Communication via 5G NR

RWS-210266 Support of Ranging in Rel-18

RWS-210267 Evolution of RedCap in Release 18

RWS-210284 NTN enhancements in Rel-18

RWS-210287 On further enhancement of sidelink in Rel-18

5 vertical areas for consideration are proposed in this discussion.

Car communication covering motivation document RWS-210088 and draft WID in RWS-210089.

Ranging support in document RWS-210266.

RedCap enhancement in document RWS-210267

NTN enhancement in document RWS-210284

Sidelink enhancement in document RWS-210287

1.1 Round 1 Question

Do you have general comments on these proposals not covered below?

Feedback Form 1: Round 1 question for genreal comments

1 – ZTE Corporation 1) For the car communication scenario, it is suggested to clarify whether the multi-mode wireless station is of UE type or gNB/DU type? If the multi-mode wireless station is of gNB/DU type, what is the difference with vehicle mounted relay defined in SA1? 2) If the multi-mode wireless stations is of UE type, what is the difference with UE-to-Network relay? 3) We are interested with the local break out service provided by the multi-mode wireless station. Suppose the multi-mode wireless station is essentially a gNB, is the local break out service based on LiPA/SIPTO in LTE, or the local switch defined in 5GC in TS 23.501? It is suggested to clarify. Actually, in our paper RWS-210472, the network based local routing of sidelink traffic is proposed. It can realize the local service between UEs in local area.
2 – CATT Q1: We hare the question as ZTE Q2 that the difference/gap compared to UE2NW relay could be further explained. Q2: We would like to understand the requirement of the backhal link, e.g., is there any new requirement on the backhaul compared with IAB/VMR, or is it just reuse of R16/17 functionality?

1.2 Round 1 Answers

#1 ZTE

>Q 1) For the car communication scenario, it is suggested to clarify whether the multi-mode wireless station is of UE type or gNB/DU type? If the multi-mode wireless station is of gNB/DU type, what is the difference with vehicle mounted relay defined in SA1?

2) If the multi-mode wireless stations is of UE type, what is the difference with UE-to-Network relay?

3) We are interested with the local break out service provided by the multi-mode wireless station. Suppose the multi-mode wireless station is essentially a gNB, is the local break out service based on LiPA/SIPTO in LTE, or the local switch defined in 5GC in TS 23.501? It is suggested to clarify. Actually, in our paper RWS-210472, the network based local routing of sidelink traffic is proposed. It can realize the local service between UEs in local area.

Ans1> Thank you for the question. I guess this Question is for our Tdoc "RWS-210088 Car communication via 5G NR". So the question is moved there. Pls see answer in **section 2.1.3 #G1.**

#2 CATT

Q> Q1: We have the question as ZTE Q2 that the difference/gap compared to UE2NW relay could be further

explained.

Q2: We would like to understand the requirement of the backhal link, e.g., is there any new requirement on the backhaul compared with IAB/VMR, or is it just reuse of R16/17 functionality?

Ans1> Thank you for the question. I guess this Question is for our Tdoc "RWS-210088 Car communication via 5G NR". So the question is moved there. Pls see answer in **section 2.1.3 #G2**

1.3 Round 2 Questions

Please submit your futher questions, if any:

Feedback Form 2: Please submit your futher questions

2 Non-eMBB Proposals for Rel-18

2.1 RAN Workshop Contribution - Car communication

2.1.1 Contribution summary

The following is a summary of contributions RWS-210088 (motivation) / RWS-210089 (draft WID), which by reference are included in their entirety to this discussion and specifically to facilitate the questions in the following related sections.

The car communication system is to use a MMWS (Multi-Mode Wireless Station) to provide the internet connection for various in-car devices and the local communication service amongst in-car devices. For example, the thermal sensor or the video camera may periodically send the captured data to the remote smart car data centre, and a user in car could use its smart phone to monitor the status (e.g. temperature and battery volume) of the smart car (via the local/remote database or directly from the sensor), or to play games (e.g. via the imbedded/localized/remote entertainment system) with other users inside/outside a car. Thus the MMWS supporting the car communication system should include the following functions:

- Support mobility between different gNBs.

- Support the local breakout service to multiple UEs.

- Support various access technologies (e.g. Wi-Fi and 3GPP Sidelink/Uu).

As the MMWS needs to support one/multiple connectivity for a mobile device within the car, car communication system needs to consider the following cases:

- Case 1 (Single-link): A mobile device connects to a gNB via the MMWS.

- Case 2 (Multi-link): A mobile device has multiple wireless links, e.g. one link directly connected to the gNB via the Uu interface and another link connected to the MMWS.

To facilitate the car communication system, a relay-like node can be used by supporting the following

functions:

- Inter-cell mobility

- (NR/LTE) Uu/WiFi/Sidelink relay to the gNB/eNB

- Local breakout service between multiple remote UEs connected to the relay station

- Link adaptation/aggregation for two simultaneous links (i.e. one direct link to gNB and one relay link via relay station, or two links (one via Uu/PC5 and one via WiFi) to the relay) for remote devices

2.1.2 Round 1 Questions

Based on the summary presented above and specifically the details of the contributions in RWS-210088 and RWS-210089, please submit below your questions for clarification or understanding according to the RAN chair guidelines, including those given in RWS-210002.

Feedback Form 3: Round 1 questions for car communication

1 – Lenovo (Beijing) Ltd Thanks for the interesting proposals, we have some clarification questions for further understanding: 1. We are interest in vehicle mounted relay (see our proposal in RWS-210255), and we are wondering whether the MMWS station is similar to vehicle mounted relay? 2. The link between remote UE and relay can support Uu/WiFi/Sidelink. Does it means the relay has the feature of sidelink relay and IAB? In addition, for the wifi interface, we have not specify it in relay topic. I wonder if the remote UE via wifi can be visible for gNB? 3. local breakout: we think local breakout is interesting and has benefit for multiple remote UEs communication in the same car. I wonder if 'local breakout service to multiple UE' implies MMWS node can support 'MBS' service?
2 – CATT It seems our previous Qs should be put here. sorry for that. Q1: We hare the question as ZTE Q2 that the difference/gap compared to UE2NW relay could be further explained. Q2: We would like to understand the requirement of the backhal link, e.g., is there any new requirement on the backhaul compared with IAB/VMR, or is it just reuse of R16/17 functionality?
3 – China Mobile Com. Corporation Thanks for your contributions! Regarding the Uu/WiFi/Sidelink relay, it seems the relay should support both sidelink relay and IAB functions. What we wonder is who takes the role of deploying the hybird mode relay, network operators or just the user(similar as home eNB). On the other hand, the local breakout in the contribution seems to be expected to support the two UEs within one same cell can communicate directly, which is more like the "local swtich" than "local breakout".

4 – Intel Corporation (UK) Ltd

[Q1] Based on proposed scope, it seems that objectives are RAN2/3 centric. Do you foresee any physical layer enhancements needed for Car Communication or you assume that baseline NR Uu/sidelink L1 design (R16/R17/R18?) is good enough?

[Q2] Is any gNB-like functionality expected at the relay UE?

5 – Intel Corporation (UK) Ltd

[Q3] Is local breakout service support referring to support of UE-to-UE relaying or some form of groupcast communication enhancement?

6 – China Telecomunication Corp.

Thanks for the good contribution for Car communication.

This is an interesting scenario. Does the wireless station located on the car only serve the devices in the car? Can other users/devices outside of the car (e.g. passerby) connect with the wireless station?

Regarding the (NR/LTE) Uu/WiFi/Sidelink relay to the gNB/eNB, we think Uu based relay and sidelink relay maybe two technical directions to achive the mobile relay located on the car. Maybe one of them is enough for the scenario. What's XIAOMI's view on the priority of the Uu based relay and sidelink relay, and reasons?

7 – TCL Communication Ltd.

This topic is interesting. We have the same question with Lenovo. Is MMWS similar to vehicle mounted relay?

8 – TCL Communication Ltd.

Ranging is a interesting topics. What could the ranging mechanism be to deal with the case of out-of-coverage NR pisitioning?

9 – China Unicom

Thanks for provide such an interesting contribution.

For the access link in car, it is similar as sidelink. While for the backhaul link, it is aggregated as IAB via NR access.

For mobility, local breakout, etc, issue, these issues can be much simplified in R18.

For relay link, it is not clear whether multi-hops relay is considered in this scenario.

2.1.3 Round 1 Answers

#G1 ZTE (This question is moved from section 1.1 #1)

Q> 1) For the car communication scenario, it is suggested to clarify whether the multi-mode wireless station is of UE type or gNB/DU type? If the multi-mode wireless station is of gNB/DU type, what is the difference with vehicle mounted relay defined in SA1?

2) If the multi-mode wireless stations is of UE type, what is the difference with UE-to-Network relay?

3) We are interested with the local break out service provided by the multi-mode wireless station. Suppose the

multi-mode wireless station is essentially a gNB, is the local break out service based on LiPA/SIPTO in LTE, or the local switch defined in 5GC in TS 23.501? It is suggested to clarify. Actually, in our paper RWS-210472, the network based local routing of sidelink traffic is proposed. It can realize the local service between UEs in local area.

Ans1> For Uu/WiFi relay, the multi-mode wireless station is gNB type. Different from the vehicle mounted relay defined in SA1, the Uu relay would require the local communication between UEs via Uu interface. However vehicle mounted relay defined in SA1 seems referring to the current IAB node which only has RLC entity. It is difficult for the current IAB node to support IP routing. Furthermore, the IAB node does not support WiFi-NR aggregation (alike LTE LWA) and the NR-NR aggregation of two Uu links.

Ans2> It is UE-to-Network relay, but with PC5-NR aggregation. Maybe this could be considered as part of the sidelink relay study.

Ans3> It is like the local switch defined in 5GC in TS 23.501. We are happy to see the network based local routing of sidelink traffic, but we would also like to have the network based local routing of Uu/WiFi traffic, and together with multi-link aggregation functions to improve the throughput.

#G2 CATT (This question is moved from section 1.1 #2)

Q> Q1: We have the question as ZTE Q2 that the difference/gap compared to UE2NW relay could be further explained.

Q2: We would like to understand the requirement of the backhal link, e.g., is there any new requirement on the backhaul compared with IAB/VMR, or is it just reuse of R16/17 functionality?

Ans1> It is UE-to-Network relay, but with PC5-NR aggregation. Maybe this could be considered as part of the sidelink relay study.

Ans2> As we would like the MMWS to support the direction IP communication between UEs, the current IAB protocols only supporting RLC layer (i.e. L2 backhaul) is not able to support the IP routing function.

#1 Lenovo (Beijing) Ltd.

Q> Thanks for the interesting proposals, we have some clarification questions for further understanding:

1. We are interest in vehicle mounted relay (see our proposal in RWS-210255), and we are wondering whether the MMWS station is similar to vehicle mounted relay?

2. The link between remote UE and relay can support Uu/WiFi/Sidelink. Does it means the relay has the feature of sidelink relay and IAB? In addition, for the wifi interface, we have not specify it in relay topic. I wonder if the remote UE via wifi can be visible for gNB?

3. local breakout: we think local breakout is interesting and has benefit for multiple remote UEs communication in the same car. I wonder if 'local breakout service to multiple UE' implies MMWS node cansupport 'MBS' service?

Ans1> The MMWS station is similar to vehicle mounted relay, but with more practical function (e.g. multiple link aggregation and local-breakout), which seems difficult for the current IAB node.

Ans2> The relay would have the feature of sidelink relay. However it is different from IAB when supporting Uu access for mobile terminals as the relay needs to support local communication between different UEs,

which is difficult for the current IAB node. Given that the current IAB node does not even have the PDCP entity, it seems not feasible for the IAB node to directly route the IP packet from one UE to another UE. The WiFi relay is visible for gNB if we support WiFi-NR aggregation, alike the LTE LWA.

Ans3> The local breakout service is to route the IP packet directly from one UE to another UE. However we are also interested in supporting MBS service.

#2 CATT

Q> Q1: We hare the question as ZTE Q2 that the difference/gap compared to UE2NW relay could be further explained.

Q2: We would like to understand the requirement of the backhal link, e.g., is there any new requirement on the backhaul compared with IAB/VMR, or is it just reuse of R16/17 functionality?

Ans1> Please see answers in **# G2 CATT.**

#3 China Mobile Com. Corporation

Q> Thanks for your contributions! Regarding the Uu/WiFi/Sidelink relay, it seems the relay should support both sidelink relay and IAB functions. What we wonder is who takes the role of deploying the hybird mode relay, network operators or just the user(similar as home eNB). On the other hand, the local breakout in the contribution seems to be expected to support the two UEs within one same cell can communicate directly, which is more like the ”local swtich” than ”local breakout”.

Ans1> We would like the user (similar as home eNB) to deploy the hybrid mode relay, as the car should be sold in a single package with all communication functions included.

#4 Intel Corporation (UK) Ltd.

Q> [Q1] Based on proposed scope, it seems that objectives are RAN2/3 centric. Do you foresee any physical layer enhancements needed for Car Communication or you assume that baseline NR Uu/sidelink L1 design (R16/R17/R18?) is good enough?

[Q2] Is any gNB-like functionality expected at the relay UE?

Ans1> Yes, the objectives are RAN2/3 centric. We are not expecting much change in L1, but we consider that if we support multi-link aggregation, we may need to consider some UE capability coordination between multiple links (alike DC), which could trigger some RAN1 study (e.g. uplink power sharing between two Uu(s), or between Uu and PC5).

Ans2> For Uu/WiFi relay, we think that the relay node is more like a gNB, which needs to support Uu access from a remote UE.

#5 Intel Corporation (UK) Ltd.

Q> [Q3] Is local breakout service support referring to support of UE-to-UE relaying or some form of groupcast communication enhancement?

Ans3> The local breakout service refers to UE-to-UE relaying. However we are also interested in supporting MBS service.

#6 China Telecomunication Corp.

Q> Thanks for the good contribution for Car communication.

This is an interesting scenario. Does the wireless station located on the car only serve the devices in the car? Can other users/devices outside of the car (e.g. passerby) connect with the wireless station?

Regarding the (NR/LTE) Uu/WiFi/Sidelink relay to the gNB/eNB, we think Uu based relay and sidelink relay maybe two technical directions to achieve the mobile relay located on the car. Maybe one of them is enough for the scenario. What's XIAOMI's view on the priority of the Uu based relay and sidelink relay, and reasons?

Ans1> We would expect the wireless station located on the car only serve the devices in the car. We hope the access control of the remote devices via the wireless station can be controlled by the car owner.

Ans2> It seems other project (i.e. sidelink relay) can cover the U2N relay function. Then our priority is to support Uu and WiFi based relay, with multi-link aggregation.

#7 TCL Communication Ltd.

Q> This topic is interesting. We have the same question with Lenovo. Is MMWS similar to vehicle mounted relay?

Ans1> The MMWS station is similar to vehicle mounted relay, but with more practical function (e.g. multiple link aggregation and local-breakout), which seems difficult for the current IAB node.

#8 TCL Communication Ltd.

Q> Ranging is a interesting topics. What could the ranging mechanism be to deal with the case of out-ofcoverage NR pisitioning?

Ans1> I guess this question is for our contribution RWS-210266 on ranging. Pls find the answer in **section 2.2.3 #13**.

#9 China Unicom

Q> Thanks for provide such an interesting contribution.

For the access link in car, it is similar as sidelink. While for the backhaul link, it is aggregated as IAB via NR access.

For mobility, local breakout, etc, issue, these issues can be much simplified in R18.

For relay link, it is not clear whether multi-hops relay is considered in this scenario.

Ans1> For PC5 relay, we agree that the U2N relay could be the baseline. However for the backhaul link, it seems that the current IAB node (which only supports RLC layer) has some difficulties to support direct communication between UEs and to support the multiple link aggregation (e.g. WiFi-NR aggregation or NR-NR aggregation).

Ans2> We would also like to have some simplified functions in Rel-18 to support our car product line.

Ans3> Considering the car communication, it seems that the multi-hop relay is not an urgent requirement.

#10 Fraunhofer HHI (This question is moved from section 2.5.2 #6)

Q> Q1: With regards to the MMWS and the local breakout service, is it capable of providing resource configurations and schedule resources to UEs inside or within the vicinity of the car in question?

Ans1> The MMWS should be able to support three types (i.e. Uu/PC5/WiFi) of wireless access, so as to allow different mobile devices to use the car communication service provided by the MMWS. For PC5 relay, we consider that the MMWS can reuse the current PC5 resource configurations (i.e. the relay node is not capable of providing the resource configurations.). For Uu relay, the relay node should provide the resource configuration alike IAB or gNB. For WiFi relay, to support the WiFi-NR aggregation, the relay node may also need to provide the source configuration.

2.1.4 Round 2 Questions

Please submit your further questions on car communication, if any:

Feedback Form 4: Please submit your further questions on Car communication

1 – HuaWei Technologies Co. 1. In Sec 2.3, for link adaptation/aggregation between two simultaneous link (direct link and indirect link), can you clarify where is the split/aggregation point you are cosidering and what's the diffrence as L2 relay multi-path aggregation?
2 – ZTE Corporation Thanks for your clarification. If the multi-mode wireless station is of gNB type and Uu traffic between UEs is delivered locally within the gNB via IP routing, what is the difference with local switch and localized UPF defined in 5GC in TS 23.501? For the multi-link aggregation, what is the difference with the multi-path aggregation discussed in sidelink relay?
3 – LG Electronics Inc. Q1: On the four scenarios depicted in Figure 2 in RWS-210088, do you assume that a single relay will play multiple functions in the figure. And we would like understand if you have some priority among the listed functions in their support in Rel-18.
4 – Samsung Electronics Co. Q1: Please elaborate more on what needs to be supported for inter-cell mobility
5 – Intel Corporation (UK) Ltd Q1 Based on responses it seems MMWS is expected to support WiFi/BT/Uu DL/Uu UL/PC5 SL and perform gNB like functionality. Please clarify whether MMWS need to support both UE (DL RX / UL TX / SL RX/TX) and gNB-like functionality (DL TX / UL RX) or either of them?
6 – China Telecomunication Corp. Thanks for the clarification. When the UEs in the car connect to the relay node located on the car via WLAN, and the relay node connects with the network via Uu, which one (the UE or the relay node located

on the car) will pay for the data flow (i.e. the UE in the car transparent to the network or not in case of relay link)?

2.1.5 Round 2 Answers

 # 1 HuaWei Technologies Co., Ltd

Q> 1. In Sec 2.3, for link adaptation/aggregation between two simultaneous link (direct link and indirect link), can you clarify where is the split/aggregation point you are cosidering and what's the diffrence as L2 relay multi-path aggregation?

Ans1> We are open to the solutions on the split/aggregation point. However, we would expect that reusing the DC split architecture with the split point at PDCP would be simpler from the specification. The PC5-Uu aggregation and WiFi-Uu aggregation are not supported so far. If the L2 relay multi-path already supports the Uu-Uu aggregation, we are ok to reuse the same architecture. However if we only support L2 relay, the local communication between UEs (e.g. via IP packet) seems difficult.

 # 2 ZTE Corporation

Q> Thanks for your clarification. If the multi-mode wireless station is of gNB type and Uu traffic between UEs is delivered locally within the gNB via IP routing, what is the difference with local switch and localized UPF defined in 5GC in TS 23.501? For the multi-link aggregation, what is the difference with the multi-path aggregation discussed in sidelink relay?

Ans1> We would like to support "local switch and localized UPF defined in 5GC in TS 23.501" for the mobile relay station. For the PC5-Uu aggregation, we are ok to reuse the multi-path aggregation discussed in sidelink relay. However, we would also like to support WiFi-Uu aggregation and Uu-Uu aggregation.

 # 3 LG Electronics Inc.

Q> Q1: On the four scenarios depicted in Figure 2 in RWS-210088, do you assume that a single relay will play multiple functions in the figure. And we would like understand if you have some priority among the listed functions in their support in Rel-18.

Ans1> We expect a single device to support multiple functions on the four scenarios depicted in Figure 2 in RWS-210088. From the perspective of Xiaomi, our priority is to support Uu relay and WiFi relay in Rel-18, as the Rel-17 sidelink relay seems already supporting some basic functions of the U2N relay and the aggregation of PC5-Uu seems already on-going in Rel-17.

 # 4 Samsung Electronics Co., Ltd

Q> Q1: Please elaborate more on what needs to be supported for inter-cell mobility

Ans1> For Uu relay, the rel-17 IAB only supports fixed relay. Some standard work would be required to support the handover signalling of the relay node from one donor gNB to another donor gNB. Furthermore, based on the protocol stacks (e.g. L2/L3 relay) of the relay node, the signalling procedure for the relay node would be different. The data transmission interruption during handover should also be considered.

 # 5 Intel Corporation (UK) Ltd

Q> Q1 Based on responses it seems MMWS is expected to support WiFi/BT/Uu DL/Uu UL/PC5 SL and perform gNB like functionality. Please clarify whether MMWS need to support both UE (DL RX / UL TX / SL RX/TX) and gNB-like functionality (DL TX / UL RX) or either of them?

Ans1> For the link between the MMWS and the UE, the MMWS needs to support UE (SL Rx/Tx) and gNB-like functionality (DL Tx and UL Rx). For the link between the MMWS and the gNB, the MMWS needs to support UE (DL Rx and UL Tx) functionality.

 # 6 China Telecomunication Corp.

Q> Thanks for the clarification. When the UEs in the car connect to the relay node located on the car via WLAN, and the relay node connects with the network via Uu, which one (the UE or the relay node located on the car) will pay for the data flow (i.e. the UE in the car transparent to the network or not in case of relay link)?

Ans1> If the UE connects to the relay node only via WLAN, we expect that the relay node will pay for the data flow. If the UE connects to the relay via both Uu and WLAN (i.e. through WiFi-Uu aggregation), the relay node should pay for WiFi data flow, and the UE should pay for Uu data flow. However, another alternative would also be possible that the UE pays for both links, as the gNB knows that the data from two links are from a specific remote UE.

2.1.6 Summary of the NWM discussion for Car communication

In the 1st round QA, 9 companies provided questions. The answers provided above clarifies the following aspects: whether the MMWS is gNB-like or UE-like, the relation between the relay function and the vehicle mounted relay defined in SA1, the relation between the relay function and the IAB, the relation between the PC-5 relay and the Rel-17 sidelink relay, clarification on the local breakout (or local switch) function, gNB visibility of WiFi-NR aggregation, whether the MMWS is deployed by the user or the operator, the potential RAN1 impact, whether to support MBS service, whether the access to the MMWS is controlled by the operator or the user, the Rel-18 standard priority of PC5/Uu/WiFi relay, whether to support multi-hop relay, and resource configuration/allocation of the MMWS.

In the 2nd round QA, 6 companies provided questions. The answers provided above clarifies the following aspects: the aggregation/split point of the multi-link aggregation, the relation between the MMWS multi-link aggregation and the L2 relay multi-path aggregation, the relation between the MMWS local breakout and the local switch and localized UPF defined in 5GC in TS 23.501, the relation between the MMWS multi-link aggregation and the multi-path aggregation discussed in sidelink relay, the Rel-18 standard priority of PC5/Uu/WiFi relay, standard impacts of inter-cell mobility, the charging scheme for the relay node and the remote UE.

2.2 RAN Workshop Contribution - Ranging

2.2.1 Contribution summary

The following is a summary and explanation of contribution RWS-210266, which is specifically to facilitate the questions in the following related sections.

This paper presents our motivation and areas for study for 3GPP RAN in REL-18, and relate to the SA1 Study: Study on Ranging based services (FS_Ranging, TR22.855). The study item was approved in SA1 #90 meeting (May 18-22, 2020), and completed in SA1 #94 meeting (May 10-20, 2021). The corresponding ranging work item (Ranging) was also completed in SA1 #94 meeting, and functional requirements and KPIs for Ranging

were captured in TS22.261.

The scope of the Ranging study item in SA1 is focus on commercial use cases other than V2X and public safety, the identified 19 use cases, e.g.:

- Distance based Smart Home Device Control Use Case

- Smart Home TV control

- Smart Vehicle key

- Distance based Intelligent Perception for Public Safety

- Picture and video sharing based on ranging results

- Hands Free Access

The following is some KPI example agreed to be captured in TS22.261 for ranging:

Table 1: Performance requirements for ranging based services

Ranging scenario	**Ranging Accuracy (95 % confidence level)**		**Availability**	**Latency** 10ms 50ms 50ms	**Effective ranging distance**	**Coverage**	**NLOS/-LOS**	**Relative UE velocity**	**Ranging interval**	**Number of concurrent ranging operation for a UE**	**Number of concurrent ranging operation in an area**
	Distance Accuracy	**Direction Accuracy**									
Distance based smart device control	10cm	-	99 %	100ms	20m	IC/PC/OOC	LOS	Static/ Moving (<1m/s)	50ms	20	-

Smart Vehicle Key	10 cm	-	99 %	50ms	30m	IC/PC/OOC	LOS	Static/ Moving (<2m/s)	25ms	-	50UEs/ ($10^4 m^2$)
Ranging of UE's in front of vending machine	20cm	10°	-	1s	5m	IC/PC/OOC	LOS	Static/ Moving (<1m/s)	50ms	-	10
distance based intelligent perception for public safety	50cm	-	99 %	-	20m	IC/PC/OOC	LOS	Static/ Moving (<20km/h)	-	100	-
Long Distance Search	20m	5°	99 %	-	100m-1km	IC/PC/OOC	LOS	Static/ Moving (up to 10m/s)	5s	-	-
Long range approximate location	[10m]	±[12.5°]	99 %	-	500m	IC/PC/OOC	LOS	Static/ Moving (<10m/s)	-	1	[50]UEs/ ($10^4 m^2$)

Besides, a new RAN level SID: "Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage positioning use cases" was approved in RAN#88 (June 29 - July 3, 2020). The scope of the SID is to:

Identify the positioning use cases and requirements for V2X and public safety, based on the existing 3GPP work and input from industry fora. Identify potential deployment and operation scenarios

The study results are captured in TR38.845. According to the latest TR38.845, the study items collects absolute & relative positioning requirements for V2X & public safety from 5GAA, SAE AA TC and TS22.186, TS22.261.

We would like to emphasize the difference between the relative positioning and ranging. In TS22.261, the relative positioning and ranging are defined separately as follow:

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.

Relative positioning requires to acquire the 2D/3D coordinates while ranging may only require a component of 2D/3D coordinates. As a result, the performance requirements for relative positioning is horizontal accuracy and vertical accuracy, as shown in the example below (From TS22.261 Table 7.3.2.2-1), while the performance requirements for ranging is distance accuracy and direction accuracy (as shown in the Ranging KPI table) (Note that horizontal accuracy comprises of distance accuracy and direction accuracy):

Table 2: Performance requirements for Horizontal and Vertical positioning service levels

Positioning service level	**Absolute(A) or Relative(R) positioning**	**Accuracy (95 % confidence level)**		**Positioning service availability**	**Positioning service latency**	**Coverage, environment of use and UE velocity**		
		Horizontal Accuracy	**Vertical Accuracy (note 1)**			**5G positioning service area**	**5G enhanced positioning service area (note 2)**	
							Outdoor and tunnels	**Indoor**

7	R	0,2 m	0,2 m	99 %	1 s	Indoor and outdoor (rural, urban, dense urban) up to 30 km/h Relative position-ing is between two UEs within 10 m of each other or between one UE and 5G position-ing nodes within 10 m of each other (note 3)		

For ranging, the distance accuracy and direction accuracy can be independent, but for relative positioning, it is not. For example, the distance accuracy for ranging may be 10cm while the direction accuracy may be 10 degree or even absent. For relative positioning, if the horizontal accuracy is 10cm, it requires both distance and direction accuracy to be very high.

Contribution RWS-210266 mainly considers the requirements from SA1 Ranging, but it can also absorb the requirements from RAN SID on relative positioning and absolute positioning. We are quite open to that. Our preference is to consider all the commercial, V2X and public safety use cases from SA1 Ranging and RAN SID together.

Our suggested RAN objective based on the current SA1 ranging requirement is as follow (can be updated to cover requirements from the RAN level SID of positioning use cases):

- The objective is to study support of Ranging. The objective of the Ranging study includes the following objectives, considering in-network coverage, out-of-network coverage, and partial network coverage:

+ Study RAN level requirements and corresponding evaluation scenarios/methodologies to enable Ranging based on requirements defined in TS22.261[RAN1]

+ Study and evaluate potential solutions for support of Ranging based on the above identified requirements, evaluation scenarios/methodologies [RAN1/RAN2]

* The solution should support Ranging with the choices of measuring only distance, measuring only angle, and measuring both distance and angle.

* The solution should support different reference signal bandwidth for different distance/angle accuracy requirement.

* The solutions should consider enabling UE to discover other UEs supporting ranging.

* The solutions should consider supporting control signaling sent over licensed band, and Ranging signal over unlicensed band.

* Ranging signal bandwidth up to [400MHz] are considered.

* Unlicensed band up to 71 GHz for Ranging signal transmission are considered.

* The solution should support one-to-one Ranging & one-to-many Ranging.

* The solution should enable power efficient Ranging with one or multiple UEs.

* The solution should enable one-hop Ranging for UEs without LOS path.

* The solution should support Reduced capability UE.

* The solution should support both network initiated and UE initiated Ranging.

2.2.2 Round 1 Questions

Based on the summary presented above and specifically the details of the contribution in RWS-210266, please submit below your questions for clarification or understanding according to the RAN chair guidelines, including those given in RWS-210002.

Feedback Form 5: Round 1 question for ranging

1 – ZTE Corporation

Thanks for the tdocs. We are interested in the requirements/proposals listed above. Please see our questions:

(1) Which of the scenarios have ranging requirement beyond the onging RAN SI scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases?

(2) Is it correct understanding that for ranging and sidelink positioning, a generally unified enhancement is expected while some particular sub-solutions may be dedicated for ranging or for sidelink positioning ?

(3) Do you think different UE capabilities are needed for ranging and sidelink positioning(relative positioning) ?

2 – Beijing Lenovo Software Ltd.

Thanks for the interesting paper. we believe ranging technology can enable quite a few use cases. Please see our questions:

1. Are there any non-3GPP technologies for ranging determination?
2. can current SL positioning item cover the ranging scenario proposed?

3 – CATT

Comments:

CATT understands it is important and supportive to provide ranging service. We assume the ranging information can be derived from the positioning information. We understand that for some scenarios, obtaining the ranging information may be easier than obtaining the absolute/relative positions. For example, one UE may derive the distance to another UE based on the measurement of the RSRP of the signals from another UE.

Questions:

Maybe Xiaomi can explain under which scenarios we want to support the ranging service without having the UE's positioning information.

4 – vivo Mobile Communication Co.

We are interested in the mentioned scenarios. One question from our side: if TDOA, AOA/AOD or RTT measurement is supported by sidelink positioning, what would be additional enhancement needed for sidelink ranging?

5 – Guangdong OPPO Mobile Telecom.

We also have interests in ranging use cases and requirements work done in SA1 and believe they should be supported in R18. We are also of an opinion that this work would be well suited to be done as part of SL positioning in R18. Ranging use cases and requirements are well defined in SA1, they can be supported right away without needing to do further study in RAN. SL positioning work item in R18 which would cover both absolute and relative positioning between devices. Would you consider the work for ranging in RAN to be done as part of SL positioning?

6 – Intel Corporation (UK) Ltd

Q1: It seems ranging based on sidelink measurements is one of the major technical components of the proposal. We would like to clarify whether you see that solutions being considered for V2X/PS will be also applicable for more general commercial use cases? We understand that there may be different technical details / requirements here and there, but overall having a separate track for ranging only services seems to be unnecessary and may lead to duplicated effort from RAN perspective. Do you have any specific suggestion in mind on how to merge V2X/PS and general commercial use cases in terms of technical work scope and where/whether you see a big difference?

Q2: Could you clarify the meaning of one-hop ranging for UEs without LOS path and how UEs know that there is no LOS path between them?

Q3: What are the typical distances associated with the ranging use cases we should consider in RAN?

Q4: Are there any security / privacy considerations on ranging, e.g. whether only authorized UEs are allowed to perform ranging, etc.?

7 – China Mobile Com. Corporation We have same question with vivo, what kind of enhancement or tailor of current sidelink positioning is required for ranging. Additionally, which use cases listed in the RWS-210266 are prioritized?
8 – Huawei Tech.(UK) Co.. Ltd You mention ”one hop”. What would be a multi-hop ranging design by contrast and/or what is the reason for one hop in particular?
9 – Sony Europe B.V. Ranging is an interesting technology. We generally support to study on support of Ranging. Starting with a study seems like a good approach. Many of the bullets under the second sub-bullet in slide 7 seem to be pre-supposed outcomes of the RAN level requirements that you propose are studied in the first sub-bullet. Hence, many of the sub-bullets can be deleted or moved. Q1: Do you expect the ranging waveform to be an NR-waveform? Q2: We consider there are other higher priority topics, such as on supporting V2X positioning. What is your view on potentially reusing the methods in V2X positioning to support ranging-based?
10 – Spreadtrum Communications Thanks for the nice contribution. We are also interested in ranging topic. And we have some clarification issues on ranging. Q1: What is the difference between ranging and sidelink positioning? Q2: Whether we need to design new positioning reference signal, such as SL-PRS , UWB or others?
11 – Qualcomm Incorporated What is the difference between one-to-one Ranging and one-to-many ranging? Wouldn’t one-to-one just a special case of one-to-many?
12 – China Unicom Thanks for this contribution. We also have interests in ranging use cases and requirements work done in SA1.What is the relationship btw ranging and positioning in R18?

2.2.3 Round 1 Answers

#1 ZTE Corporation

Q> Thanks for the tdocs. We are interested in the requirements/proposals listed above. Please see our questions:

(1) Which of the scenarios have ranging requirement beyond the onging RAN SI scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases?

(2) Is it correct understanding that for ranging and sidelink positioning, a generally unified enhancement is

expected while some particular sub-solutions may be dedicated for ranging or for sidelink positioning ?

(3) Do you think different UE capabilities are needed for ranging and sidelink positioning (relative positioning)?

Ans1> Thank you for the valuable comments.

Sidelink positioning RAN SI considers only V2X and public safety, while ranging WI in SA1 considers commercial and public safety use case. For commercial use case, there are a lot scenarios involving IOT devices, which have much more strict requirements on power consumption and cost than vehicles. And the moving speed is stationary or considerably low than vehicles. The antenna design for vehicles is also quite different from IoT devices. From the requirement point of view, the sidelink positioning RAN SI has only considered a very limited KPIs, i.e. horizontal and vertical accuracy, latency, availability, confidence level, while ranging also defines distance accuracy, direction accuracy, effective ranging distance, concurrent ranging operations, etc. Ranging also defined many functional requirements including e.g. ranging discovery, power efficient ranging, one-hop ranging, stationary/mobile determination, UE and network triggered ranging, etc. As such, ranging provides a good supplement to the current sidelink positioning RAN SI.

Ans2> yes, a unified solution would be preferred and sub options to allow different operation.

Ans3> This can be decided during the WI phase. Either unified capability with multiple-parameters or different capability can be considered, we slightly prefer the former one.

#2 Beijing Lenovo Software Ltd.

Q> Thanks for the interesting paper. we believe ranging technology can enable quite a few use cases. Please see our questions:

1. Are there any non-3GPP technologies for ranging determination?

2. can current SL positioning item cover the ranging scenario proposed?

Ans1> Thank you for the valuable comments.

Yes, UWB, Bluetooth, and Wifi are also having technologies to support ranging.

Ans2> Please see **#1 ZTE Q1 Ans1>**

#3 CATT

Q> Comments: CATT understands it is important and supportive to provide ranging service. We assume the ranging information can be derived from the positioning information. We understand that for some scenarios, obtaining the ranging information may be easier than obtaining the absolute/relative positions. For example, one UE may derive the distance to another UE based on the measurement of the RSRP of the signals from another UE.

Questions: Maybe Xiaomi can explain under which scenarios we want to support the ranging service without having the UE's positioning information.

Ans1>Thank you for the valuable comments and questions.

For example, in smart home scenario, the positioning information is not available. Devices can be controlled

based on its distance and or direction to the user

#4 vivo Mobile Communication Co.

Q> We are interested in the mentioned scenarios. One question from our side: if TDOA, AOA/AOD or RTT measurement is supported by sidelink positioning, what would be additional enhancement needed for sidelink ranging?

Ans1>Thank you for the valuable comments.

Regarding the distance/angle measurement, from solution point of view, we think a unified solution is preferred for ranging and relative positioning. Some sub-options would be needed to support ranging and relative positioning, e.g. to separately enable/disable distance measurement and angle measurement and set different parameters targeting different accuracy requirement. Besides, low power consumption and low cost UE support should be taken into account for ranging for IOT devices. Furthermore, ranging WI in SA1 also defined many functional requirements including e.g. ranging discovery, power efficient ranging, one-hop ranging, stationary/mobile determination, UE and network triggered ranging, etc. These requirements should also be taken into account.

#5 Guangdong OPPO Mobile Telecom.

Q> We also have interests in ranging use cases and requirements work done in SA1 and believe they should be supported in R18. We are also of an opinion that this work would be well suited to be done as part of SL positioning in R18. Ranging use cases and requirements are well defined in SA1, they can be supported right away without needing to do further study in RAN. SL positioning work item in R18 which would cover both absolute and relative positioning between devices. Would you consider the work for ranging in RAN to be done as part of SL positioning?

Ans1> Thank you for the valuable comments.

We agree that ranging and SL positioning should be done in one work item.

#6 Intel Corporation (UK) Ltd

Q> Q1: It seems ranging based on sidelink measurements is one of the major technical components of the proposal. We would like to clarify whether you see that solutions being considered for V2X/PS will be also applicable for more general commercial use cases? We understand that there may be different technical details / requirements here and there, but overall having a separate track for ranging only services seems to be unnecessary and may lead to duplicated effort from RAN perspective. Do you have any specific suggestion in mind on how to merge V2X/PS and general commercial use cases in terms of technical work scope and where/whether you see a big difference?

Q2: Could you clarify the meaning of one-hop ranging for UEs without LOS path and how UEs know that there is no LOS path between them?

Q3: What are the typical distances associated with the ranging use cases we should consider in RAN?

Q4: Are there any security / privacy considerations on ranging, e.g. whether only authorized UEs are allowed to perform ranging, etc.?

Ans1> Thank you for the valuable comments.

From technical point of view, we think ranging and sidelink positioning can have a unified solution in RAN for measuring distance and angle, there is no need to have separate WI for both. From scenario and requirements point of view, ranging can serve as a supplement to the RAN SI. Ranging WI in SA1 considers both commercial and public safety use case. For commercial use case, there are a lot scenarios involving IOT devices, which have much more strict requirements on power consumption and cost than vehicles. And the moving speed is stationary or considerably low than vehicles. The antenna design for vehicles is also quite different from IoT devices. The ranging WI in SA1 have defined a complete set of KPIs and functional requirements while the sidelink positioning RAN SI has only considered a very limited KPIs(horizontal and vertical accuracy, latency, availability, confidence level). The KPIs from ranging like distance accuracy, direction accuracy, effective ranging distance, concurrent ranging operations, moving speed should be considered, and also functional requirements from ranging to be considered include e.g. ranging discovery, power efficient ranging, one-hop ranging, IOT device support, mutual ranging, one2many ranging, secure ranging, stationary/mobile determination, UE and network triggered ranging, etc.

Ans2> one-hop ranging refers to the SA1 requirement:

The 5G system shall be able to support mechanisms for a UE to assist another UE to perform ranging of a third UE (if the requesting UE is LOS with the assisting UE and the assisting UE is LOS with the third UE).

There is technology to decide whether there is LOS path or not between devices, which is discussed in positioning WI. Note that WiFi has already supported LOS determination.

Ans3> Different distance will have different accuracy requirement. The ranging distance defined in SA1 range from 1m-1km. For indoor cases, such as smart home, the typical effective ranging distance would be around 10-20m. For outdoor cases, the typical effective ranging distance would be around 20-1km.

Ans4> Yes, SA1 have defined security requirement on ranging, e.g.:

The 5G system shall be able to authorize ranging for a UE or a group of UE when using licensed spectrum.

The 5G system shall be able to protect privacy of a UE and its user, ensuring that no identifiable information can be tracked by undesired entities during ranging.

The 5G system shall support means to securely identify other ranging capable UEs, with which a certain UE can perform ranging.

The 5G system shall be able to ensure the integrity and confidentiality of ranging information used by ranging-enabled UEs.

The 5G system shall be able to ensure security protection (e.g., interworking security) when the ranging concerns UEs subscribed with different operators.

The level of security provided by the existing 5G system shall not be adversely affected when ranging is enabled.

#7 China Mobile Com. Corporation

Q> We have same question with vivo, what kind of enhancement or tailor of current sidelink positioning is required for ranging. Additionally, which use cases listed in the RWS-210266 are prioritized?

Ans1>Thank you for the valuable comments. Please see answers in **#4 VIVO**.

Ans2> All use cases in the documents as well as use cases in the TR22.855 can be supported. Actually, there is no difficulty to support all the use cases, a unified solution can be developed.

#8 Huawei Tech.(UK) Co.. Ltd

Q> You mention ”one hop”. What would be a multi-hop ranging design by contrast and/or what is the reason for one hop in particular?

Ans1> Thank you for the valuable comments.

SA1 has the following requirement on one hop ranging:

The 5G system shall be able to support mechanisms for a UE to assist another UE to perform ranging of a third UE (if the requesting UE is LOS with the assisting UE and the assisting UE is LOS with the third UE).

Multi-hop ranging was discussed in SA1 and the conclusion is not to support in rel-18 due to complexity.

#9 Sony Europe B.V.

Q> Ranging is an interesting technology. We generally support to study on support of Ranging. Starting with a study seems like a good approach. Many of the bullets under the second sub-bullet in slide 7 seem to be pre-supposed outcomes of the RAN level requirements that you propose are studied in the first sub-bullet. Hence, many of the sub-bullets can be deleted or moved.

Q1: Do you expect the ranging waveform to be an NR-waveform?

Q2: We consider there are other higher priority topics, such as on supporting V2X positioning. What is your view on potentially reusing the methods in V2X positioning to support ranging-based?

Ans1> Thank you for the valuable comments.

If licensed spectrum is used, NR-waveform may be better. If unlicensed spectrum is used, perhaps new waveform can be considered to better cope with multi-path issue.

Ans2> Please see answers in **#4 VIVO**

#10 Spreadtrum Communications

Q> Thanks for the nice contribution. We are also interested in ranging topic. And we have some clarification issues on ranging.

Q1: What is the difference between ranging and sidelink positioning?

Q2: Whether we need to design new positioning reference signal, such as SL-PRS , UWB or others?

Ans1> Thank you for the valuable comments.

Firstly, we would like to clarify the difference of definition between ranging and relative positioning:

In TS22.261, the relative positioning and ranging are defined separately as follow:

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.

Relative positioning requires to acquire the 2D/3D coordinates while ranging may only require a component of 2D/3D coordinates. As a result, the performance requirements for relative positioning is horizontal accuracy and vertical accuracy, while the performance requirements for ranging is distance accuracy and direction accuracy (Note that horizontal accuracy comprises of distance accuracy and direction accuracy).

For ranging, the distance accuracy and direction accuracy can be independent, but for relative positioning, it is not. For example, the distance accuracy for ranging may be 10cm while the direction accuracy may be 10 degree or even absent. For relative positioning, if the horizontal accuracy is 10cm, it requires both distance and direction accuracy to be very high.

Secondly, we would like to emphasize the requirement difference between SA1 ranging WI and RAN SI.

RAN SI considers V2X and public safety use case, Ranging WI in SA1 considers commercial and public safety use case. For commercial use case, there are a lot scenarios involving IOT devices, which have much more strict requirements on power consumption and cost than vehicles. And the moving speed is stationary or considerably low than vehicles. The antenna design for IOT devices is also quite different from vehicles.

Besides,the ranging WI in SA1 have defined a complete set of KPIs and functional requirements while the sidelink positioning RAN SI has only considered a very limited KPIs(horizontal and vertical accuracy, latency, availability, confidence level). The KPIs from ranging like distance accuracy, direction accuracy, effective ranging distance, concurrent ranging operations, moving speed should be considered, and also functional requirements from ranging to be considered include e.g. ranging discovery, power efficient ranging, one-hop ranging, IOT device support, mutual ranging, one2many ranging, secure ranging, stationary/mobile determination, UE and network triggered ranging, etc.

In general, we think ranging requirements can serve as a supplement to sidelink positioning requirements identified in RAN. A unified solution would be preferred for both ranging and relative positioning considering requirements from both ranging and RAN SI.

Ans2> There are many options, e.g. reusing PRS/SRS, defining new NR ranging signals, using non-3GPP technologies (UWB). It can be decided in the WI phase. We prefer to define new NR ranging signals at least for unlicensed band.

#11 Qualcomm Incorporated

Q> What is the difference between one-to-one Ranging and one-to-many ranging? Wouldn't one-to-one just a special case of one-to-many?

Ans1> Thank you for the valuable comments.

For one-to-many ranging, one UE can simultaneously range with a lot of other UEs, solutions may be taken into account to simplify the procedure.

#12 China Unicom

Q> Thanks for this contribution. We also have interests in ranging use cases and requirements work done in

SA1.What is the relationship btw ranging and positioning in R18?

Ans1> Thank you for the valuable comments.

if I understand correctly, you mean the relationship between ranging and sidelink positioning, right?

Then pls see answer in **#10 spreadtrum Ans1>.**

#13 TCL Communication Ltd. (the question is moved from section **2.1.2 #8**)

Q> Ranging is a interesting topics. What could the ranging mechanism be to deal with the case of out-ofcoverage NR pisitioning?

Ans1>Thank you for the valuable comments.

In many indoor scenarios, devices may be out of coverage. For example, for smart home cases, devices are connected through wifi. Ranging can be used for smart device control, e.g. based on the distance and/or angle to control the device you point at or closest to you.

2.2.4 Round 2 Questions

Please submit your further questions on Ranging, if any:

Feedback Form 6: Please submit your further questions on Ranging

1 – Huawei Tech.(UK) Co.. Ltd Thanks for the answer. An additional question is, for the device pointing example on page 2, is there an accuracy requirement on the direction between the UEs?
2 – Intel Corporation (UK) Ltd Q1: Thank you for clarifying that "ranging and sidelink positioning can have a unified solution in RAN for measuring distance and angle, there is no need to have separate WI for both". We agree to that observation. Could you clarify whether/which unique objectives you would like to see as a part of sidelink positioning/ranging study – is that about power saving, ranging discovery? Q2: We are also promoting support of LOS/NLOS classification for NR positioning on Uu links and believe it can be useful for sidelink as well. Could you clarify further the advantage and use case for one-hop ranging using two LOS links vs direct NLOS ranging (it seems both will have inevitable error in distance / angle errors)?
3 – Samsung Electronics Co. Q1: If we specify relative positioning in Rel-18 sidelink positioning WI, the use cases identified for ranging based service (SA1 R18 WI) can be covered by relative positioning because the relative positioning in RAN Rel17 SI targets more tight requirements for mission critical communications such as public safety and V2X. How do you this about this? Do you have any other motivation? Q2: In page 7, potential scope are overlapped with Rel-18 sidelink enhancements and sidelink positioning. What is your view on this independent SI only for ranging? (Similar question as above)

2.2.5 Round 2 Answers

#1 Huawei

Q> Thanks for the answer. An additional question is, for the device pointing example on page 2, is there an accuracy requirement on the direction between the UEs?

Ans1> Thanks for the question. This use case refers to section 5.8 "Smart Transportation Metro/Bus Validation"of TR22.855, there is no direction accuracy defined for this case. However,in our understanding, there is no limitation for solutions to use both distance and direction for this case.

#2 Intel

Q> Q1: Thank you for clarifying that "ranging and sidelink positioning can have a unified solution in RAN for measuring distance and angle, there is no need to have separate WI for both". We agree to that observation. Could you clarify whether/which unique objectives you would like to see as a part of sidelink positioning/ranging study – is that about power saving, ranging discovery?

Q2: We are also promoting support of LOS/NLOS classification for NR positioning on Uu links and believe it can be useful for sidelink as well. Could you clarify further the advantage and use case for one-hop ranging using two LOS links vs direct NLOS ranging (it seems both will have inevitable error in distance / angle errors)?

Ans1> Firstly, it is not about whether the requirements are unique or not. It is about whether the requirements are identified or not. For example, one-hop ranging is identified by SA1 ranging WI, but RAN SI on sidelink positioning has no discussion on this. Thus, the identified full set of requirements can serve as a complementary requirement for both V2X, public safety, and commercial use cases. The potential complementary requirements may be: distance accuracy, direction accuracy, effective ranging distance, concurrent number of ranging operations, ranging discovery, power efficient ranging, one-hop ranging, mutual ranging, one2many ranging, secure ranging, stationary/mobile determination, UE and network triggered ranging, etc.

Secondly, you are correct that there are some uniqueness of commercial use cases, e.g.power saving, low cost:

- Power saving: solution should be designed to meet the strict power consumption requirement of IOT devices.

- Low cost: solution should take into account RedCap UE with lower bandwidth and 1Rx.

- Security/Privacy: For commercial cases, ranging may be performed between devices whose location does not link to user location, ranging can be performed without secure link.

- Capacity: For commercial cases, the density of devices can be considerably larger than V2X scenario, system capacity should be considered to accommodate large number of UEs initiating ranging.

Ans2> Thanks for the question. NLOS has significant impact on the accuracy of distance/angle measurement. High accuracy can not be achieved through NLOS. With the help of third UE with LOS link, accuracy can be improved.

#3 Samsung

Q> Q1: If we specify relative positioning in Rel-18 sidelink positioning WI, the use cases identified for ranging based service (SA1 R18 WI) can be covered by relative positioning because the relative positioning in

RAN Rel17 SI targets more tight requirements for mission critical communications such as public safety and V2X. How do you this about this? Do you have any other motivation?

Q2: In page 7, potential scope are overlapped with Rel-18 sidelink enhancements and sidelink positioning. What is your view on this independent SI only for ranging? (Similar question as above)

Ans1> Firstly,it is not about the differences between use cases of R17 RAN sidelink positioning SI and SA1 ranging.It is about the completeness of requirements. RAN SI on sidelink positioning does not provide a full set of requirements. Ranging has been well studied in SA1, so a full set of requirements are provided, which can serve as a complement to RAN SI outcome. For example, one-hop ranging is identified by SA1 ranging WI, but RAN SI on sidelink positioning has no discussion on this. Thus, the identified full set of requirements can serve as a complementary requirement for both V2X, public safety, and commercial use cases. The potential complementary requirements may be: distance accuracy, direction accuracy, effective ranging distance, concurrent number of ranging operations, ranging discovery, power efficient ranging, one-hop ranging, mutual ranging, one2many ranging, secure ranging, stationary/mobile determination, UE and network triggered ranging, etc.

Secondly, there are some uniqueness of commercial use cases, e.g. power saving, low cost:

- Power saving: solution should be designed to meet the strict power consumption requirement of IOT devices.

- Low cost: solution should take into account RedCap UE with lower bandwidth and 1Rx.

- Security/Privacy: For commercial cases, ranging may be performed between devices whose location does not link to user location, ranging can be performed without secure link.

- Capacity: For commercial cases, the density of devices can be considerably larger than V2X scenario, system capacity should be considered to accommodate large number of UEs initiating ranging.

Ans2> We think there is no need to have separate WI for sidelink positioning and ranging. Both can be covered in one WI with a unified solution defined to meet all the requirements.

2.2.6 Summary of the NWM discussion for Ranging

The two questions most companies ask are:

1□What aspects of ranging is not covered by R17 RAN SI of sidelink positioning

2□Whether sidelink positioning and ranging will have different solution and separate SI/WI

Our answer are provided as below:

Ans1> Firstly, due to limited time of R17 RAN sidelink positioning SI, it only considers very limited requirements, e.g. horizontal and vertical accuracy. However, SA1 ranging is well studied and output a full set of requirements. For example, one-hop ranging is identified by SA1 ranging WI, but RAN sidelink positioning SI has no discussion on this. Thus, the identified full set of requirements from SA1 ranging can serve as a complement for both V2X, public safety, and commercial use cases. The potential complementary requirements may be: distance accuracy, direction accuracy, effective ranging distance, concurrent number of ranging operations, ranging discovery, power efficient ranging, one-hop ranging, mutual ranging, one2many ranging, secure ranging, stationary/mobile determination, UE and network triggered ranging, etc.

Secondly, you are correct that there are some uniqueness of commercial use cases, e.g.power saving, low cost:

- Power saving: solution should be designed to meet the strict power consumption requirement of IOT devices.

- Low cost: solution should take into account RedCap UE with lower bandwidth and 1Rx.

- Security/Privacy: For commercial cases, ranging may be performed between devices whose location does not link to user location, ranging can be performed without secure link.

- Capacity: For commercial cases, the density of devices can be considerably larger than V2X scenario, system capacity should be considered to accommodate large number of UEs initiating ranging.

Ans2> From our point of view there is no need to have separate WI for sidelink positioning and ranging. Both can be covered in one WI with a unified solution defined to meet all the requirements.

2.3 RAN Workshop Contribution - Redcap

2.3.1 Summary

The following is a summary and explanation of contribution RWS-210267, which is specifically to facilitate the questions in the following related sections.

During Release 17, basic framework and functionalities are to be established for RedCap. In Release 18, eRedCap should aim to expand more use cases and applications to enrich the market. In Xiaomi's view, positioning in Redcap, sidelink RedCap and unlicensed Redcap are important aspects for eRedCap.

UE positioning and tracking are important in many IoT applications, such as children tracking via wearables and asset tracking via industrial sensors. However, the narrow UE bandwidth poses challenges for the positioning accuracy when using 3GPP positioning functionalities defined for normal UEs. In this case the study on the positioning accuracy is needed. In addition, due to the small factor, the battery capacity is limited for RedCap devices. In this case more power-efficient solutions are more desirable.

Supporting sidelink interface on Redcap could enable the interaction between RedCap wearables and smart phone or the interaction between the industrial sensor and the control center directly. In addition, the sidelink relay function could enable the smart phone to relay the data of RedCap wearable to network for power saving and coverage extension. However, when importing RedCap into the sidelink system. Solutions to guarantee good coexistence between UEs with different capabilities should be specified.

In the industrial scenario, utilizing unlicensed band is usual. Industrial sensor is one important use case for RedCap and they work on the unlicensed band should be considered as well. However, due to the limited UE bandwidth, the monitored narrow frequency resource would be easily blocked, which would impose negative impact on the channel access and data transmission. Thus how to support RedCap to work on the unlicensed bands should be carefully studied.

2.3.2 Round 1 Questions

Based on the summary presented above and specifically the details of the contribution in RWS-210267, please submit below your questions for clarification or understanding according to the RAN chair guidelines, including those given in RWS-210002.

Feedback Form 7: Round 1 questions for Redcap

1 – Classon Consulting FUTUREWEI supports studying redcap positioning, but should be in positioning not redcap (seems you have a similar view).
2 – Spreadtrum Communications Thank you for the nice contribution. First of all, we think positioning in RedCap is meaningful, especially for the children tracking scenario you mentioned in your slides. For the positioning accuracy, what is the positioning KPIs from your perspective? Whether Rel-16/Rel-17 positioning can meet the requirements? Secondly, we also think access to unlicensed band is very important for RedCap. In our understanding, in order to maintain the fairness, the LBT BW should no smaller than 20MHz. When the maximum bandwidth is further reduced from 20Mhz, how to mantain the fairness? Can we just say the RedCap with smaller BW(e.g. <20MHz) cannot access to unlicensed band?
3 – Intel Corporation (UK) Ltd Q1: Thanks for RedCap contribution. You have highlighted Sidelink RedCap and Unlicensed RedCap. Do you also consider Unlicensed Sidelink RedCap and if so what are the main use cases, KPIs and market opportunities according to your views?
4 – Huawei Tech.(UK) Co.. Ltd Could you expand on what is the issue for coexistence between normal SL UEs, and a proposed RedCap SL UE? The RedCap limited bandwidth would seem to fit inside a configurable resource pool bandwidth, for example.
5 – MediaTek Inc. Thank you for sharing your views. We share your view that accurate positioning, Sidelink and unlicensed spectrum operation should be supported by RedCap. However, we prefer that positioning and sidelink topics are discussed in an associated work item to have all the relevant experts in the same room. We also have the following questions: Q1: What gaps do you see regarding RedCap operation in unlicensed spectrum in Rel-17? Q2: What gaps do you see regarding RedCap Sidelink operation in Rel-17?
6 – LG Electronics Inc. Q1) What is the motivations of sidelink support for RedCap UEs from your perspective?

2.3.3 Round 1 Answers

#1 FUTUREWEI

Q> supports studying redcap positioning, but should be in positioning not redcap (seems you have a similar view).

Ans1> Thank you for your comments. We are open to discuss which project will handle this topic. As a

starting point, we think we can follow previous principle to handle other cross-project topic. If some additional design/enhancement is RedCap-specific, then we think it should be handled in RedCap project. On the other hand, if the additional design/enhancement is common for all UEs, then it can be handled in the positioning project.

#2 Spreadtrum Communications

Q>Thank you for the nice contribution.

First of all, we think positioning in RedCap is meaningful, especially for the children tracking scenario you mentioned in your slides. For the positioning accuracy, what is the positioning KPIs from your perspective? Whether Rel-16/Rel-17 positioning can meet the requirements?

Secondly, we also think access to unlicensed band is very important for RedCap. In our understanding, in order to maintain the fairness, the LBT BW should no smaller than 20MHz. When the maximum bandwidth is further reduced from 20Mhz, how to mantain the fairness? Can we just say the RedCap with smaller BW(e.g. <20MHz) cannot access to unlicensed band?

Ans1> Thank you for your questions.

For your first question, we think the positioning accuracy requirement depends on the target service or application scenario. As a starting point, we think we can reuse the existing Rel-16/Rel-17 positioning requirement. But anyway, we need to clarify the requirement at the start of the RedCap positioning work.

Ans2> For your second question, we think you raise a good question. In your contribution, we see you propose to support LBT bandwidth smaller than 20MHz, that may be one direction. But in our view, the work of supporting bandwidth smaller than 20MHz is not started yet. So, in release 18, we could focus on supporting RedCap with 20MHz on unlicensed band. When the framework of supporting bandwidth less than 20MHz is stable, we could further discuss how to support Redcap with smaller bandwidth on the unlicensed band.

#3 Intel Corporation (UK) Ltd

Q> Q1: Thanks for RedCap contribution. You have highlighted Sidelink RedCap and Unlicensed RedCap. Do you also consider Unlicensed Sidelink RedCap and if so what are the main use cases, KPIs and market opportunities according to your views?

Ans1> Thank you for your question, we are also interested in the SL-U RedCap. The potential use case can be in the industrial scenario, in the industrial scenario, utilizing unlicensed band is common. Then, enable interaction among the industrial sensors or between the industrial sensors and the control center via SL-U can be considered.

But considering the work of SL-U is not started in 3GPP, we think maybe we don't need to go directly to support SL-U RedCap in release 18. This topic can be started when the framework of SL-U is stable.

#4 Huawei Tech.(UK) Co.. Ltd

Q> Could you expand on what is the issue for coexistence between normal SL UEs, and a proposed RedCap SL UE? The RedCap limited bandwidth would seem to fit inside a configurable resource pool bandwidth, for example.

Ans1> Thank you for your question. In our understanding, the main challenge comes from the reduced UE bandwidth. For example, currently only one SL BWP is configured, then when RedCap is introduced, how to

configure the SL BWP considering different bandwidth capability? One direction is to configure separate SL BWP. On the other hand, as you mentioned, a suitable resource pool can be configured for RedCap, no matter the SL BWP is larger than UE's BW or not. That is also one direction. We are open with either way or any other directions. But no matter which directions we choose, we envision there would be some standardization work.

#5 MediaTek Inc.

Q> Thank you for sharing your views. We share your view that accurate positioning, Sidelink and unlicensed spectrum operation should be supported by RedCap. However, we prefer that positioning and sidelink topics are discussed in an associated work item to have all the relevant experts in the same room. We also have the following questions:

Q1: What gaps do you see regarding RedCap operation in unlicensed spectrum in Rel-17?

Q2: What gaps do you see regarding RedCap Sidelink operation in Rel-17

Ans1> Thank you for your question.

For your first question, in our understanding, due to the limited UE bandwidth, the RedCap can only be configured with a BWP with up to e.g., 20MHz. which correspond to one LBT BW. While for the normal UE with wideband width, a wide BWP including multiple LBT BW can be configured. For RedCap, once this one LBT BW is occupied, the RedCap have no other resource to use. While for the normal UE, it is possible that other LBT BW is available and can be used. So, compared with the normal UE, the RedCap UEs have lower probability to access to the channel.

Ans2> For your second question, in our understanding, the main challenge comes from the reduced UE bandwidth. For example, currently only one SL BWP is configured, then when RedCap is introduced, how to configure the SL BWP considering different bandwidth capability? One direction is to configure separate SL BWP. On the other hand, as mentioned by some other company, a suitable resource pool can be configured for RedCap, no matter the SL BWP is larger than UE's BW or not. That is also one direction. We are open with either way or any other directions. But no matter which direction we choose, we envision there would be some standardization work.

#6 LG Electronics Inc.

Q> Q1) What is the motivations of sidelink support for RedCap UEs from your perspective?

Ans1> Thank you for your question. From our perspective, the main motivation is to support the interaction between wearables and smartphones via sidelink. For example, direct information sharing between wearables and smartphones can be enabled via sidelink. Furthermore, the smartphone could help wearable to relay its' data to the NW for the purpose of coverage extension and power saving. In addition, we thinking supporting side link RedCap is also helpful in the industrial scenario. For example, it could enable the direction communication among industrial sensors or between the industrial sensor and control center.

2.3.4 Round 2 Questions

Please submit your further questions on Redcap, if any:

Feedback Form 8: Please submit your futher questions on Red-cap

1 – vivo Communication Technology Thanks for the contribution. In addition to the enhancements mentioned in in the contribution, we wonder what is your view on the following potential areas for Rel-18 eRedCap? 1) Peak data rate reduction (by reduced BW, or TBS/RB restriction) 2) Lower UE power class 3) reduced number of HARQ processes 4) relaxed UE processing time for data/CSI 5) serving cell RRM relaxation 6) coverage recovery
2 – Spreadtrum Communications Thank you for your detailed answers. As mentioned in your answers, the work of supporting bandwidth smaller than 20MHz is not started yet. Then, we just want to ask your views on the further cost reduction. From our perspective, the bandwidth reduction is an important aspect for very low complexity devices, e.g. sensors. As reply to you in our NWM Q&A, for access to unlicensed band, when the BW is further reduced from 20Mhz, maybe we can specify a smaller ED threshold for the RedCap to maintain the fairness. Besides, it's worth noting that in some dedicated frequency band or scenarios, LBT is not needed, the fairness issue may not exist. Therefore, from our perspective, BW reduction below 20MHz can be considered for both licensed and unlicensed band.
3 – Samsung Electronics Polska Q1: for SL+RedCap, if the target use case is for personal IoT and SL is between RedCap and non-Redcap (e.g., a smart phone), why not configure a smaller BWP for both of them?

2.3.5 Round 2 Answers

#1 vivo Communication Technology

Q> Thanks for the contribution. In addition to the enhancements mentioned in in the contribution, we wonder what is your view on the following potential areas for Rel-18 eRedCap?

1) Peak data rate reduction (by reduced BW, or TBS/RB restriction)

2) Lower UE power class

3) reduced number of HARQ processes

4) relaxed UE processing time for data/CSI

5) serving cell RRM relaxation

6) coverage recovery

Ans1> Thanks for your answer

(1) For the peak data rate reduction, we are open to discuss this topic. From our perspective, we agree with the motivation for the peak data reduction. But for the detailed solution, especially for the BW reduction, we don't expect to redesign the SSB. our baseline is to reuse the existing SSB

(2) For the lower UE power class, we think it is one direction for the UE power saving, we are open to discuss it as well

(3)(4)(5) For the reduced number of HARQ process, relaxed UE processing time for data/CSI and serving cell RRM relaxation, we think we have discussed these topics deeply and have common understanding on the pros and cons in R17. So, we don't see strong need to restart the discussion in R18.

(6) For the coverage recovery, we are supportive to this enhancement. In R17, we have already identified some coverage issues in the DL. In R17, with the enhancement of the UL coverage, the coverage imbalance between DL and UL will become more severe.

#2 Spreadtrum Communications

Q> Thank you for your detailed answers. As mentioned in your answers, the work of supporting bandwidth smaller than 20MHz is not started yet. Then, we just want to ask your views on the further cost reduction. From our perspective, the bandwidth reduction is an important aspect for very low complexity devices, e.g. sensors.

As reply to you in our NWM Q&A, for access to unlicensed band, when the BW is further reduced from 20Mhz, maybe we can specify a smaller ED threshold for the RedCap to maintain the fairness. Besides, it's worth noting that in some dedicated frequency band or scenarios, LBT is not needed, the fairness issue may not exist.

Therefore, from our perspective, BW reduction below 20MHz can be considered for both licensed and unlicensed band.

Ans1>

Thank you for further sharing your consideration. Yes, we agree with you some enhancement can be raised to solve the problem in case of UE bandwidth smaller than 20MHz. And we also agree with that if some dedicated frequency band or very pure unlicensed band (e.g., no interference from WiFi), there is no need to use LBT. We are open to discuss t utilizing unlicensed band for RedCap UE with bandwidth smaller than 20MHz, once further BW reduction is agreed for the licensed band.

#3 Samsung Electronics Polska

Q> for SL+RedCap, if the target use case is for personal IoT and SL is between RedCap and non-Redcap (e.g., a smart phone), why not configure a smaller BWP for both of them?

Ans1> Configuring a smaller BWP for RedCap and smartphone is also one solution, but it would incur negative impact on the flexibility of non-RedCap devices. Because in current SL system, only one SL BWP is allowed and restricting this SL BWP impact the non-RedCap UE. To be more specific, when Redcap is imported into the SL system, there are 3 types communication. They are RedCap to RedCap communication, RedCap to non-RedCap communication and non-RedCap to non-RedCap communication. If the SL BWP is

restricted, it will impact on the communication between non-RedCap and non-RedCap. This situation is similar to the discussion of initial BWP configuration in current Release 17 RedCap.

2.3.6 Summary of the NWM discussion for RedCap

In the NWM discussion, we received comments/questions from 8 companies and the questions/comments are mainly related to the following aspects:

1) Views on further cost reduction

2) How to handle the discussion of RedCap positioning.

3) Motivation of supporting SL requirement and what's the gap to support SL RedCap by using existing solutions or rely on NW configuration

4) What's the gap to support RedCap to operate in the unlicensed band and how to support RedCap device with bandwidth smaller than 20MHz to operate on unlicensed band.

For the cost reduction, we are open to discuss further cost reduction. But we suggest to focus on the solutions with significant cost reduction and avoid restart the discussion we have done in the release 17.

For the RedCap positioning, we are happy to see many companies are aligned on the motivation. In the following discussion, we suggest to focus on the requirement, evaluation methodology and potential enhancement directions. After these issue are clarified, we could decide which project (RedCap or Positioning) to handle this issue.

For the sidelink RedCap, there are also many companies are interested in this topic. But we may have different views on whether existing solution is sufficient and which project to handle this enhancement. So, as next step, we plan to elaborate the problem of supporting SL Redcap and make it more clear

For unlicensed RedCap, there are also some companies interested in this topic. But further clarification on the potential problem is needed. As for supporting RedCap with bandwidth smaller than 20MHz to operate on unlicensed band, we think we could touch this issue after further bandwidth reduction is agreed for the licensed band.

2.4 RAN Workshop Contribution - NTN

2.4.1 Summary

The following is a summary of contribution RWS-210284, which is specifically to facilitate the questions in the following related sections.

In Rel-17, the essential design for enabling satellite communication is specified for VSAT/handheld/IoT devices. In Rel-18, we see a need to continue the standard work to support the enhanced performance from the following aspects.

- Support of new service type

In SA1 94e meeting, a new WI [S1- 211371] is approved on 5G system with satellite access to Support Control and/or Video Surveillance. The support of the video surveillance service may require higher data rate

(several Mbps in the UL). It is needed to specify the enhancements to support higher data rate to meet the service requirement in Rel-18.

- Unreliable/unavailable GNSS

The time/frequency sync in Rel-17 design relies on the UE's location information via GNSS. However, the UE reported location information based on the GNSS may not be reliable as indicated in [R2-2102679]. Meanwhile, the GNSS signals may be blocked in some scenarios such as indoor. In this sense, the network based positioning solutions can be considered in Rel-18.

- Support of smart phone

Support of smart phone is an essential aspect to enable commercial usage of satellite communication. The Tx/Rx antenna gain assumed for smart phone is around -5dbi which is 5 dB lower than the assumption for the handheld devices which may leads to coverage issue.

- TN/NTN integration

It is important to guarantee the service quality and reduce UE power consumption for UE mobility between TN and NTN. The Rel-17 mechanism for service continuity between TN and NTN will lead much handover interruption and UE power consumption. It is needed to specify the enhancements to support enhanced integration between TN and NTN.

Based on our analysis, the following enhancements should be considered in Rel-18 NTN enhancement:

- Data rate enhancement

- Positioning enhancement

- Coverage enhancement

- Mobility enhancement

2.4.2 Round 1 Questions

Based on the summary presented above and specifically the details of the contribution in RWS-210284, please submit below your questions for clarification or understanding according to the RAN chair guidelines, including those given in RWS-210002.

Feedback Form 9: Round 1 questions for NTN

1 – Asia Pacific Telecom co. Ltd We share the same view that unreliable/unavailable GNSS shall be considered. However, we wonder whether NTN-based positioning, UE without GNSS, or UE with GNSS but without UL timing/freq. pre-compensation shall be supported in Rel-18.
2 – THALES About NTN proposed features, we do agree that Rel-18 should allow to define features that will optimize NTN performances especially to address smartphones. Also we concur with the need to optimize mobil-

ity procedures to reduce radio link interruptions and UE power consumption. The definition of a RAT dependent positioning scheme for NTN (NGSO) is also of interest to address the high accuracy and reliability/trustability requirements of regulated services (e.g. emergency calls) for UE with or without GNSS capability.

What features do you consider in order to provide a 25 Mbps data rate on the uplink ?

What UE performance characteristics do you consider for coverage enhancements ?

3 – Lenovo (Beijing) Ltd

We are interested in the NTN proposals in this contribution. Please see our questions:

(1) For the data rate enhancement part, as you mentioned that video/photo based surveillance requires 1Mbps in DL and maybe 25Mbps in UL, does it mean that ”Enhanced beam management schemes to support multi-beam operation e.g, by CA-like scheme within a Satellite” is mainly for UL?

And if ”Coordinated transmissions using multiple beams from different satellites” is feasible as it requires coordination of different satellites? For transparent mode the coordination may experience severe delays and for regenerative mode the coordination may require ISL.

(2) For the positioning enhancement part, if GNSS is unavailable due to UE in a deep fading area, will ”positioning with single/multiple satellite(s)” be available considering the similar situation? And how to enhance?

(3) For the coverage enhancement part, do you consider supporting SUL in NTN?

(4) For the mobility enhancement part, do you only consider enhancements between NTN and TN? DC-like HO and DAPS could also be useful in NTN mobility.

4 – China Telecommunications

We share the same view of the coverage and mobility challenges in NTN. Our questions are shown as follows:

1) Since coverage enhencement for TN is ongoing in R17, which methods can be reused in R18 NTN scenario? And what is the specific aspect should be considered in NTN?

2) As for mobility between TN and NTN, what is the payload of satellites? Transparent of regenerative? We think it would mainly cause different RAN3 impacts.

5 – Spreadtrum Communications

Thanks for the contribution with attractive points. We have the following questions and comments:

² For the data rate enhancement

· You mentioned CA-like scheme within a satellite. Do you support both intra-band CA and inter-band CA?

· For coordinated transmissions using multiple beams from different satellites, is the cooperative transmission between GEO satellite and Non-GEO satellite within your consideration? How to handle the issue due to the differential delay among different satellites?

² For coverage enhancement, we agree that UL coverage should be enhanced especially for smart phone in NTN.

6 – China Mobile Com. Corporation

Regarding the issue of Unreliable/unavailable GNSS and the study of TN/TNT integration, we are supportive. But for the support of the video surveillance service requiring higher data rate (several Mbps in the UL), we are wondering what kind of enhancement can meet the target under the UL power limitation condition in NTN network.

7 – ZTE Corporation

Thanks for your proposal. In general, we are also positive on the further enhancement on NTN with some aspects listed in our contribution (RWS-210468). W.r.t the proposal from your side, clarification on following aspects are preferred□

Q1: The positioning enhancement is one potential area, is there any views on architecture related since the RAN3 is added as one WG group?

Q2: For the coverage enhancement part, we share the views that there is still gaps to enable the direct connection to satellite by smart phone. But w.r.t the evaluation, can we take same assumption on the UE's RF capability, e.g., antenna gain?

8 – HUAWEI TECHNOLOGIES Co. Ltd.

Q1: What is the exact specification impact of "multi-beam operation" to support the CA-like scheme within a satellite? Do you foresee any changes compared to current UE procedure with respect to Scell activation/deactivation?

Q2: On the "coordinated transmissions using multiple beams from different satellites", what is the exact transmission scheme, e.g. mTRP, DC? Are you assuming transparent payload or regenerative payload?

9 – Sony Corporation

Thanks for the contribution. We have four questions.

- For data enhancement
  - What UE form factor is considered? What is the UE antenna gain?
- For positioning enhancement
  - Is the proposal for a study item or for a study phase within a work item?
- For Coverage enhancement
  - What UL / DL data rates are supported?
  - Can the study consider circularly polarized antennas at the UE to improve coverage?

10 – CATT We also interest in the objectives mentioned in the contribution, i.e. enhancement to beam management, positioning,coverage and TN/NTN coordination. Question for mobility: What's the expected mobility enhancement? we see you propose to consider CA/DC operation between TN and NTN. Do you expect to do any enhancement on handover/reselection? and what do you think of the coordination between LEO and GEO, e.g. DC operation?
11 – LG Electronics France We agree that enhancements for higher data rate and UE power consumption efficiency for UE mobility between TN and NTN are needed. For data rate enhancement, not only CA-like scheme, how do you think about multiple connectivity from multiple satellites?
12 – China Unicom Thanks for sharing your view on NTN enhancement in Rel-18. We share the same view to support coverage enhancement in R18.

2.4.3 Round 1 Answers

#1 Asia Pacific Telecom co. Ltd

Q> We share the same view that unreliable/unavailable GNSS shall be considered. However, we wonder whether NTN-based positioning, UE without GNSS, or UE with GNSS but without UL timing/freq. pre-compensation shall be supported in Rel-18.

Ans1>Thanks for the question.

We notice that two solutions are proposed to resolve the non-GNSS issue, one solution is to introduce network based positioning in NTN; the other one solution is to introduce enhanced time/frequency compensation schemes without relying on positioning information. Our preference is to have network based positioning in Rel-18, however, we are also open to discuss other solutions.

#2 THALES

Q> About NTN proposed features, we do agree that Rel-18 should allow to define features that will optimize NTN performances especially to address smartphones. Also we concur with the need to optimize mobility procedures to reduce radio link interruptions and UE power consumption. The definition of a RAT dependent positioning scheme for NTN (NGSO) is also of interest to address the high accuracy and reliability/trustability requirements of regulated services (e.g. emergency calls) for UE with or without GNSS capability.

What features do you consider in order to provide a 25 Mbps data rate on the uplink ?

What UE performance characteristics do you consider for coverage enhancements ?

Ans1> Thanks for the question.

The 25Mbps is only an example (from the high end video of video surveillance service in Redcap WI), of

course the exact requirement on the data rate for video of video surveillance service is still under discussion in SA, we can wait for SA's decision.

Ans2>For the coverage enhancement, we should identify the target channels that have coverage issue under the common evaluation assumption such as the traffic type, beam layout and UE assumption. The UE's performance requirement is related to the service type, candidate service type could be voice service.

#3 Lenovo (Beijing) Ltd

Q> We are interested in the NTN proposals in this contribution. Please see our questions:

(1) For the data rate enhancement part, as you mentioned that video/photo based surveillance requires 1Mbps in DL and maybe 25Mbps in UL, does it mean that "Enhanced beam management schemes to support multi-beam operation e.g, by CA-like scheme within a Satellite" is mainly for UL?

And if "Coordinated transmissions using multiple beams from different satellites" is feasible as it requires coordination of different satellites? For transparent mode the coordination may experience severe delays and for regenerative mode the coordination may require ISL.

(2) For the positioning enhancement part, if GNSS is unavailable due to UE in a deep fading area, will "positioning with single/multiple satellite(s)" be available considering the similar situation? And how to enhance?

(3) For the coverage enhancement part, do you consider supporting SUL in NTN?

(4) For the mobility enhancement part, do you only consider enhancements between NTN and TN? DC-like HO and DAPS could also be useful in NTN mobility.

Ans1> Thanks for the questions.

For the data rate enhancement. To support the video surveillance service (detailed performance requirement can be further discussed), at least the UL enhancement should be considered. Meanwhile, we also supportive to further evaluate the DL performance to check if there is a performance gap to support the service included in TR 38.821. For the coordination between different satellites, we do agree that this is subject to the delay between different satellites. For the satellites in same/different orbits that are close to each other, the delay may be quite small.

Ans2> For the positioning enhancement, it is possible that UE cannot receive the GNSS signals while can still receive the signal from satellites in LEO. In this sense, it is still possible UE can acquire positioning information using network based positioning.

Ans3> For the coverage, our understanding is that the motivation to have SUL is to provide the UL cell in low frequency to guarantee the coverage performance. Given that in NTN, the target bands can includes S/L bands, we don't see the need to have SUL at this stage.

Ans4> For mobility enhancement, we agree that mobility between TN/NTN, as well as between NTN should be considered.

#4 China Telecommunications

Q> We share the same view of the coverage and mobility challenges in NTN. Our questions are shown as follows:

1) Since coverage enhencement for TN is ongoing in R17, which methods can be reused in R18 NTN scenario? And what is the specific aspect should be considered in NTN?

2) As for mobility between TN and NTN, what is the payload of satellites? Transparent of regenerative? We think it would mainly cause different RAN3 impacts.

Ans1> Thanks for the questions.

The existing coverage enhancement such as repetition should be the starting point. For the coverage enhancement in NTN scenario, we should identify the target channels that have coverage issue under the common evaluation assumption. The evaluation assumption might be different compared to what we have in CE WI in Rel-17.

Ans2> For the mobility enhancement between TN and NTN, we think this applies to both transparent and regenerative payload cases. The mobility enhancement in our minds can includes the enhanced measurement to reduce UE's power consumption which may also have impact on RAN1/RAN2.

#5 Spreadtrum Communications

Q> Thanks for the contribution with attractive points. We have the following questions and comments:

For the data rate enhancement

- You mentioned CA-like scheme within a satellite. Do you support both intra-band CA and inter-band CA?

- For coordinated transmissions using multiple beams from different satellites, is the cooperative transmission between GEO satellite and Non-GEO satellite within your consideration? How to handle the issue due to the differential delay among different satellites?

For coverage enhancement, we agree that UL coverage should be enhanced especially for smart phone in NTN.

Ans1> Thanks for the questions.

For the CA-like operation, we think both intra-band and inter-band CA should be considered at this stage.

Ans2> For the coordination between different satellite, the coordination between GEO and NON-GEO, as well as between Non-GEO satellites in different orbits should be considered. Surely the timing delay should be considered which is dependent on the deployment scenario, this should be further studied.

#6 China Mobile Com. Corporation

Q> Regarding the issue of Unreliable/unavailable GNSS and the study of TN/TNT integration, we are supportive. But for the support of the video surveillance service requiring higher data rate (several Mbps in the UL), we are wondering what kind of enhancement can meet the target under the UL power limitation condition in NTN network.

Ans1> Thanks for questions.

For the UEs served by satellites in relatively low orbits. It is possible that UE is capable enough to get higher data rate using multiple connections. However, we do agree that the UE's power limitation is an important aspect that needs to be taken into account.

#7 ZTE Corporation

Q> Thanks for your proposal. In general, we are also positive on the further enhancement on NTN with some aspects listed in our contribution (RWS-210468). W.r.t the proposal from your side, clarification on following aspects are preferred

Q1: The positioning enhancement is one potential area, is there any views on architecture related since the RAN3 is added as one WG group?

Q2: For the coverage enhancement part, we share the views that there is still gaps to enable the direct connection to satellite by smart phone. But w.r.t the evaluation, can we take same assumption on the UE's RF capability, e.g., antenna gain?

Ans1> Thanks for the question.

For the network based positioning utilizing single satellite, e.g, using multi- RTT/RSTD with single node in different time. It might be beneficial to put the LMF on RAN side, this may involve RAN3's work.

Ans2> For the coverage enhancement, we do share your view that common assumptions on the UE should be considered.

#8 HUAWEI TECHNOLOGIES Co. Ltd.

Q> Q1: What is the exact specification impact of "multi-beam operation" to support the CA-like scheme within a satellite? Do you foresee any changes compared to current UE procedure with respect to Scell activation/deactivation?

Q2: On the "coordinated transmissions using multiple beams from different satellites", what is the exact transmission scheme, e.g. mTRP, DC? Are you assuming transparent payload or regenerative payload?

Ans1> Thanks for the questions.

Regarding the CA-like scheme, the time-varying timing difference between different serving cells need to be considered. Meanwhile, enhancements on the beam management is also expected.

Ans2> For the coordinated transmission, the detailed schemes can be further discussed depending on the detailed deployment scenarios such as timing delay between different satellites. Both transparent payload and regenerative payload can enjoy the benefits from supporting multiple connections.

#9 Sony Corporation

Q> Thanks for the contribution. We have four questions.

For data enhancement

- What UE form factor is considered? What is the UE antenna gain?

For positioning enhancement

- Is the proposal for a study item or for a study phase within a work item?

For Coverage enhancement

- What UL / DL data rates are supported?

- Can the study consider circularly polarized antennas at the UE to improve coverage?

Ans1> Thanks for the questions.

For the date rate enhancement, the target UE type should be at least includes VSAT/handheld/smart phone/Redcap devices. For the UE antenna gain, we should have a common assumption within 3GPP. This is also related to the coverage issue, at least for the smart phone, our understanding is that -5 -6dBi should be considered to enable the support of smart phone in NTN system.

Ans2> For the positioning enhancement, we suggest to have a study phase within a work item, as it is important to have a common understanding on the accuracy requirement of the positioning in NTN.

Ans3> For the coverage enhancement, the target date rate is related to the service we supported in Rel-18.

Ans4> UEs equipped with circularly polarized antennas can surely enjoy improved performance, however, UEs with linear polarized antennas should also be considered.

#10 CATT

Q> We also interest in the objectives mentioned in the contribution, i.e. enhancement to beam management, positioning, coverage and TN/NTN coordination.

Question for mobility:

What's the expected mobility enhancement? we see you propose to consider CA/DC operation between TN and NTN. Do you expect to do any enhancement on handover/reselection? and what do you think of the coordination between LEO and GEO, e.g. DC operation?

Ans1> Thanks for the questions.

For the mobility enhancement, it is important to guarantee the service quality and reduce UE power consumption for UE mobility between TN and NTN. For handover, the DC between TN and NTN can be considered as a solution to reduce handover interruption, for the enhancements on Cell selection/reselection between NTN and TN, potential enhancements on measurements also can be considered to reduce the UE power consumption.

Ans2> Coordination between satellites on different orbits is attractive to us. The satellite on the higher orbit can provide the coverage, while the satellite on the lower orbit can provide higher throughput. UE can be associated to multiple satellites, detailed schems such as CA/DC can be further discussed.

#11 LG Electronics France

Q> We agree that enhancements for higher data rate and UE power consumption efficiency for UE mobility between TN and NTN are needed. For data rate enhancement, not only CA-like scheme, how do you think about multiple connectivity from multiple satellites?

Ans1> Thanks for the question.

We do see a need to support higher data rate in Rel-18 NTN. Besides the CA-like scheme within a satellite, we are supportive to work on the multiple connectivity from multiple satellites, e.g, by DC or other potential

schemes.

#12 China Unicom

Q> Thanks for sharing your view on NTN enhancement in Rel-18.

We share the same view to support coverage enhancement in R18.

Ans1> Thanks for the comment. Glad to see we share the view on the coverage enhancement.

2.4.4 Round 2 Questions

Please submit your further questions on NTN, if any:

Feedback Form 10: Please submit your futher questions on NTN

1 – ZTE Corporation Thanks for your replies. As following-up question on the positioning part, the discussion to enable the LMF at RAN side has been discussed for TN in past release without consensus. If we trigger it for NTN, it will also have impacts on the legacy system. Any views on how to deal with the potential overlapping with TN positioning? Do we need to take it within one or different items? More specifically, for the NTN positioning, is it only applied for the satellite with re-generative payload (e.g., full-gNB on board to mitigate the impacts on latency for positioning process)?
2 – China Unicom Thanks for your contribution and clarification. Generally, video and photo based surveillance applications requires 1Mbps to downbload data and 25Mbs to upload respectively, which are not guaranteed with the existing NTN. Thus, does the solution meet the high data rate needs? And what's the enhanced data rate requirements from NTN scenarios, i.e. satellite, UAV, or HAPS?

2.4.5 Round 2 Answers

#1 ZTE Corporation

Q> Thanks for your replies. As following-up question on the positioning part, the discussion to enable the LMF at RAN side has been discussed for TN in past release without consensus. If we trigger it for NTN, it will also have impacts on the legacy system. Any views on how to deal with the potential overlapping with TN positioning? Do we need to take it within one or different items? More specifically, for the NTN positioning, is it only applied for the satellite with re-generative payload (e.g., full-gNB on board to mitigate the impacts on latency for positioning process)?

Ans1> Thanks for the following up questions.

For LMF at RAN side, we see some companies also propose it in the NR positioning enhancement item. So if the LMF at RAN side is introduced for positioning enhancement, we should handle it in one item, and perform feasible evaluation to introduce it in another item. For example, we can discuss the LMF at RAN side function in NR positioning enhancement item, and then introduce it to NTN positioning.

We think NTN positioning can be applied for both regenerative payload and transparent payload. The LMF at satellite will reduce positioning latency, so we think the function of LMF at RAN side is more feasible to apply for the re-generative payload.

#2 China Unicom

Q> Thanks for your contribution and clarification. Generally, video and photo based surveillance applications requires 1Mbps to downbload data and 25Mbs to upload respectively, which are not guaranteed with the existing NTN. Thus, does the solution meet the high data rate needs? And what's the enhanced data rate requirements from NTN scenarios, i.e. satellite, UAV, or HAPS?

Ans1> Thanks for the questions.

Firstly, it needs to be clarified that the target data rate here [DL: 1Mbps, UL: 25Mbps] is only an example (from the high end video of video surveillance service in Redcap WI), of course the exact requirement on the data rate for video of video surveillance service is still under discussion in SA, we can wait for SA's decision.

Regarding the solutions to meet the service requirement, the multi-connection solutions can boost the UE's data rate in our understanding. However, if this is still not sufficient subject to the requirement, we are open to discuss other solutions.

Regarding the scenarios that have higher data rate requirement, 5G system with satellite access can provide data connection for equipment (such as wind power plant/pole, solar power plant/panel) control and/or video surveillance by mobile and stationary UEs as indicated in S1-211371. This could be realized by UAV, HAPS or satellite.

2.4.6 Summary of the NWM discussion for NTN

Xiaomi's proposal on NTN enhancement is captured in RWS-210284. In Rel-17, the essential design for enabling satellite communication is specified for VSAT/handheld/IoT devices. In Rel-18, we see a need to continue the standard work to support the enhanced performance from the following aspects.

1) Data rate enhancement

2) Positioning enhancement

3) Coverage enhancement

4) Mobility enhancement

During the two rounds email discussion via NWM, twelve companies provided their questions/comments. Based on the discussion, it is observed that:

For data rate enhancement, some companies questioned about the target scenario, requirements and candidate solutions for supporting higher data rate. It seems companies have much interests on the multi-connections.

For the positioning enhancement, majority companies seem to have a common views that the non-GNSS issue needs to be handled in Rel-18. However, some companies prefer to introduce network based positioning in NTN; some other companies prefer to introduce enhanced time/frequency compensation schemes without relying on positioning information. It is valid to have further study in Rel-18.

For coverage enhancement, companies providing the comments seem to agree on the issue identified, however, further discussion is needed on the detailed evaluation and solutions

For the mobility enhancement, companies providing comments questioned about the detailed solutions to resolve the mobility issue. Further discussion is needed.

2.5 RAN Workshop Contribution - Sidelink

2.5.1 Summary

The following is a summary of contributions RWS-210287, which is specifically to facilitate the questions in the following related sections.

In Rel-18, further enhancement on NR sidelink operation should be considered, including at least the following:

Multi-carrier operation for sidelink can effectively increase the data rate of sidelink communication, which is required by advanced V2x applications, commercial services such as XR, etc. In addition, flexible combinations among licensed band, unlicensed band and dedicated ITS band can be considered.

Flexible sidelink BWP can be useful for many V2x/PS/commercial use cases, especially on power saving and UE cost/complexity reduction.

Although sidelink operation in licensed or ITS-dedicated band is expected to be beneficial to guarantee the stringent QoS requirement e.g. on reliability and latency, it is more and more important and interesting to consider using unlicensed spectrum as a complementary source of spectrum to improve the data connectivity among sidelink devices. Both in-coverage, partial-coverage and out-of-coverage should be considered. Sidelink operation purely in unlicensed spectrum without assistant of licensed or ITS spectrum should be supported.

Further enhancement on sidelink relay feature can also be considered, including:

- UE-to-UE Relay support

- Multi-hop for U2N and U2U

- Mixed licensed and unlicensed configuration

+ priority on U2N with Uu licensed and PC5 unlicensed operation

- Mobility Enhancement

+ Inter-gNB

+ Group mobility (Relay UE and Remote UEs)

- Multi-link (Remote UE support simultaneous UP Uu and PC5(relay) connectivity)

2.5.2 Round 1 Questions

Based on the summary presented above and specifically the details of the contribution in RWS-210287, please submit below your questions for clarification or understanding according to the RAN chair guidelines, including those given in RWS-210002.

Feedback Form 11: Round 1 Questions for sidelink

1 – Classon Consulting FUTUREWEI also supports sidelink unlicensed
2 – LG Electronics Inc. Q1: The idea of flexible SL BWP seems to support different BWP configurations for different UE types, capabilities, etc, and require configuring multiple SL BWPs. If so, is this multiple SL BWP configuration from a UE perspective or a system perspective? In the latter, still from a single UE perspective, only one SL BWP can be selected for use, e.g., depending on the service or device types.
3 – CATT Thanks for the contribution. For SL relay part, we generally agree that relay work should continue in Rel-18, as stated in our paper RWS-210407.
4 – Intel Corporation (UK) Ltd Q1: Thanks for contribution. Could you clarify whether flexible sidelink BWP configuration includes support of different SL-BWPs from TX and RX UE perspective? Q2: Support of mixed licensed and unlicensed configuration is emphasized for U2N relay use case. Could you clarify why priority is given for U2N only, which essentially relies on sidelink communication in unlicensed spectrum? In our understanding, support of sidelink communication in unlicensed is a more general building block that can be used to support U2N relaying.
5 – HuaWei Technologies Co. Q1: Do you think it is feasibe to go to 71 GHz for SL unlicensed in a single release, or should we go in steps, starting with up to 60 GHz?
6 – Fraunhofer HHI Q1: With regards to the MMWS and the local breakout service, is it capable of providing resource configurations and schedule resources to UEs inside or within the vicinity of the car in question?
7 – Qualcomm Technologies Int Is flexible sidelink BWP configuration per carrier or across all aggregated carriers?
8 – CATT Do you consider unlicensed sidelink and UE relay as separate WIs or do you want to have this topic combined with other sidelink enhancements?

2.5.3 Round 1 Answers

#1 Classon Consulting/ Futurewei

Q> FUTUREWEI also supports sidelink unlicensed

Ans1> Thank you for the valuable comments. We are happy to see our understanding is aligned.

#2 LG Electronics Inc.

Q> Q1: The idea of flexible SL BWP seems to support different BWP configurations for different UE types, capabilities, etc, and require configuring multiple SL BWPs. If so, is this multiple SL BWP configuration from a UE perspective or a system perspective? In the latter, still from a single UE perspective, only one SL BWP can be selected for use, e.g., depending on the service or device types.

Ans1> Thank you for the valuable comments.

From our understanding, the flexible SL BWP configuration should be supported from both UE perspective and system perspective.

From system perspective, different BWPs can be configured for devices with different UE type/capacities. For example, a BWP with 20MHz bandwidth is configured for Redcap UEs, and a 100MHz bandwidth BWP is configured for full capacity UEs. Different BWPs can also be configured for different services. For example, in smart home scenario, 100MHz BW with 60KHz SCS is configured for XR gaming devices to achieve high throughput & low latency, but 20MHz BW with 15KHz SCS can be configured for controller, sensors, etc. in the room to reduce cost and power.

From a single UE perspective, supporting a UE configured with multiple BWPs would also be beneficial. Different SL BWP with different SCS or frequency domain resource can be configured for devices or services. For a UE which needs to perform SL communication with all these devices, multiple BWP configurations should be supported. For example, different apps in a smart phone may need to perform SL comm. with XR devices, wearable devices, and smart sensors in home, each of which has a different BWP configuration. On the other hand, flexible BWP switch can be helpful for power saving.

Currently we assume only a single SL BWP can be activated at a time, but we are open to discuss whether multiple BWPs can be activated simultaneously.

#3 CATT

Q> Thanks for the contribution. For SL relay part, we generally agree that relay work should continue in Rel-18, as stated in our paper RWS-210407 .

Ans1> Thank you for the valuable comment. We are happy to see our understanding is aligned.

#4 Intel Corporation (UK) Ltd

Q> Q1: Thanks for contribution. Could you clarify whether flexible sidelink BWP configuration includes support of different SL-BWPs from TX and RX UE perspective?

Q2: Support of mixed licensed and unlicensed configuration is emphasized for U2N relay use case. Could you clarify why priority is given for U2N only, which essentially relies on sidelink communication in unlicensed

spectrum? In our understanding, support of sidelink communication in unlicensed is a more general building block that can be used to support U2N relaying.

Ans1> Thank you for the question.

From our understanding, we still do not see the necessity to support separate Tx-SL-BWP and Rx-SL-BWP for a UE. But we are open to further discuss this topic.

Ans2> We agree the sidelink unlicensed is the building block towards use of an unlicensed hop in the relay scenario. We specifically highlight the U2N scenario as a priority as we see this as the more immediate need for commercial interests e.g. enterprise, in-home and wearables including health and fitness.

#5 HuaWei Technologies Co.

Q> Q1: Do you think it is feasible to go to 71 GHz for SL unlicensed in a single release, or should we go in steps, starting with up to 60 GHz?

Ans1> Thank you for the question.

From our viewpoint, in Rel-18 SL-U, at least the enhancements to enable SL operation in FR1 and FR2 unlicensed band should be included. We are open to discuss whether the enhancement specific for 52.6-71GHz is included considering overall R18 workload and TU allocation.

#6 Fraunhofer HHI

Q> Q1: With regards to the MMWS and the local breakout service, is it capable of providing resource configurations and schedule resources to UEs inside or within the vicinity of the car in question?

Ans1> Thank you for the question.

I guess this Question is for our Tdoc "RWS-210088 Car communication via 5G NR". So the question is moved there. Pls see answer in **section 2.1.3 #10**

#7 Qualcomm Technologies Int.

Q> Is flexible sidelink BWP configuration per carrier or across all aggregated carriers?

Ans1> Thanks for the question.

In this contribution we are considering flexible sidelink BWP configuration per carrier. But we are open to discuss SL BWP across carriers.

#8 CATT

Q> Do you consider unlicensed sidelink and UE relay as separate WIs or do you want to have this topic combined with other sidelink enhancements?

Ans1> Thank you for the question.

We support both enhancements to be included in Rel-18. We are open to discuss whether they are discussed in a single WI or separate WIs.

2.5.4 Round 2 Questions

Please submit your further questions on Sidelink enhancement, if any:

Feedback Form 12: Please submit your further questions on Sidelink enhancement

1 – LG Electronics Inc. Q1: Regarding your answer on the flexible SL BWP, can you explain the benefit of changing SCS in the example of "XR gaming devices" and "controller, sensors, etc in the room?" I assume one benefit of 60 kHz SCS could be a shorter TTI but another solution like the mini slot might serve the same purpose with keeping the SCS. Do you see some benefit from another viewpoint?
2 – Intel Corporation (UK) Ltd Q1: Could you clarify your main motivation/use case to enhance sidelink BWP frameworks? Which benefits it can bring to sidelink ?

2.5.5 Round 2 Answers

 # 1 LG Electronics Inc.

Q> Q1: Regarding your answer on the flexible SL BWP, can you explain the benefit of changing SCS in the example of "XR gaming devices" and "controller, sensors, etc in the room?" I assume one benefit of 60 kHz SCS could be a shorter TTI but another solution like the mini slot might serve the same purpose with keeping the SCS. Do you see some benefit from another viewpoint?

Ans1> Thank you very much for the further question.

Yes, for XR gaming services both high throughput and low latency are required, and thus higher SCS would be beneficial from both bandwidth and delay perspective. Although shorter TTI can also achieve lower latency, potential additional GP in-between TTIs may reduce the resource efficiency. We are not objecting discussing mini-slot/shorter TTI in Rel18 SL enhancement, but we also think flexible BWP would be beneficial to support.

 # 2 Intel Corporation (UK) Ltd

Q> Q1: Could you clarify your main motivation/use case to enhance sidelink BWP frameworks? Which benefits it can bring to sidelink ?

Ans1> Thank you for the question. In summary, we think it could be beneficial for the following reasons:

1) to enable sidelink communication among UEs with different capacity;

2) to enable flexible sidelink BWP configuration for services with different bandwidth/latency requirements;

3) to save sidelink UE power consumption;

2.5.6 Summary of the NWM discussion for Sidelink

In the NWM discussion, we received comments/questions from 8 companies in the 1st round, and further comments/questions from 2 companies in the 2nd round. The most raised questions/comments are related to the clarification on flexible sidelink BWP configurations, including its motivation, scope, etc. There are also some comments/questions on unlicensed sidelink, sidelink relay, etc.

A brief summary of our consideration and response on flexible sidelink BWP is given below:

We think it is beneficial to consider flexible sidelink BWP in Rel-18 sidelink enhancement as it can:

- enable sidelink communication among UEs with different capacity;

- enable flexible sidelink BWP configuration for services with different bandwidth/latency requirements; and

- save sidelink UE power consumption.

We think the flexible SL BWP configuration should be supported from both UE perspective and system perspective. We are open to discuss the following related issues:

- whether multiple BWPs can be activated simultaneously;

- SL BWP across carriers

- Separate Tx-SL-BWP and Rx-SL-BWP for a UE.