[RAN94e-R18Prep-04] Sidelink enhancements (excluding positioning and relaying) - Version 0.0.7

RAN

3GPP TSG RAN Meeting #94-e RP-212664

Electronic Meeting, December 6 - 17, 2021

Source: RAN1 Chair (Samsung)

Title: Moderator's summary for discussion on [RAN94e-R18Prep-04] Sidelink enhancements (excluding positioning and relaying)

Document for: Discussion and Decision

1 Introduction

Please note some of the general guidelines provided by the RAN Chair in RP-212657.

The goal of the email discussion is to focus on potential scope/areas for each potential WI or SI, with NO intention to update the set and the organization of the topics as endorsed in RP-212608.

1. *Aim to identify whether a topic should be a SI, or WI (including possibly a study phase for some scope(s))*
2. *Aim to identify on the leading WG (including if any change compared with those in RP-212608) and the secondary WG(s)*
3. *Aim to identify on the potential interaction with SA/CT*
4. *All companies are expected to provide comments including detailed justification for areas/scopes for each topic in discussion*

2 Initial Round

According to the guidelines provided by the RAN Chair in RP-212657 for the initial round, the goal is to summarize proposals for further discussion, including those for areas/objectives. For the initial round discussion on sidelink enhancement, RP-212503 from RAN#93-e will be used as a starting point. The following was captured in RP-212503 for potential areas/objectives for sidelink enhancement:

- Sidelink carrier aggregation
- Enhancement to support sidelink on FR1 unlicensed spectrum
- Enhanced sidelink operation on FR2 licensed spectrum
- Enhancements for sidelink power saving
- Co-channel coexistence of LTE sidelink and NR sidelink

2.1 Collection of company views

2.1.1 General Views

Companies are invited to provide general high-level views on '[RAN94e-R18Prep-04] Sidelink enhancements (excluding positioning and relaying)' (if any). Any views on the following aspects are also welcome:

- Whether this work should be a SI, or WI
- Leading WG (including if any change compared with those in RP-212608) and the secondary WG(s)
- Whether there is need for potential interaction with SA/CT

Feedback Form 1:

1 – TELECOM ITALIA S.p.A.

As stated during the previous round of discussion, we do not see an urgent market need for most of these enhancements. On the other hand 2.1.5 and 2.1.6 are important to support Vulnerable Road Users (VRUs) and NR PC5 deployment.

Proposal: Work Item focused on 2.1.5 and 2.1.6.

2 – Ericsson LM

The list of topics above in quite long and some of the topics have a huge associated workload (e.g., SL in unlicensed spectrum and, especially SL on FR2 spectrum). Given, the experiences in Rel-16 and Rel-17 with huge delays in some WGs (especially in RAN1, the leading WG), we think that the scope should be very limited, preferably to a single topic.

The agreed scope of the item will determine whether it is a WI or a SI. In our view:

· For the topics CA, co-channel coexistence, and power saving enhancements, a WI is appropriate. In some cases, a short study in power saving enhancements could be suitable too.

· For the topic of SL on unlicensed FR1, a WI with an initial study phase is most suitable.

· For the topic of SL on licensed FR2, a SI would be necessary, as most of the conclusions from the NR V2X SI were drawn under the (sometimes implicit) assumption of FR1 spectrum.

We would like to emphasize that the previous list of bullets does not imply our support for any topic. It simply states our views on whether a WI/SI is suitable *if* the topic is to be addressed.

In terms of scope, our preferences are (ordered from high to low):

1. Single WI on SL for unlicensed FR1 spectrum
2. Single WI on SL-CA and co-channel coexistence
3. Single WI on SL-CA and SL for unlicensed FR1 spectrum (with an initial study phase) – In this case, the scope of SL for unlicensed FR1 spectrum would have to be quite limited.

Our view is that RAN1 should be the leading WG. RAN2 and RAN4 will definitely be secondary groups. Whether RAN3 is also a secondary group will again depend on the scope of the WI/SI. Given that a parallel

item on SL relays is being discussed, our view is that the TU allocation for secondary groups should be kept small (esp. RAN2, leading group for SL relays).

We think that the interaction with SA/CT, if any, will be very limited.

3 – LG Electronics Inc.

We think this work should be a WI, but some objectives may need to have a study phase to identify the exact scope of the normative work. We think RAN1 will be the leading WG and RAN2/4 need to be involved as the secondary WGs. We expect some potential interaction with SA/CT but this can be confirmed after the work scope becomes clearer.

4 – Nokia France

This can be a WI, but the number of objectives within it should be minimised, considering the extensive overflow of sidelink work that has taken place in most previous releases; the same mistake should not be made in Rel-18.

RAN1 is expected to be the lead WG, with RAN2 also impacted.

5 – DOCOMO Communications Lab.

Rel-18 SL scope should be small sufficiently. In Rel-16 and Rel-17, SL progress was quite slow and many maintenance discussions were/will be experienced. To avoid same situation, limited scope is preferable.

This topic can be WI, but some study might be necessary at the beginning of this WI. Leading WG should be RAN1 and RAN2/4 would be secondary WGs.

6 – vivo Communication Technology

In our view the Rel-18 SL enhancement can be a WI, with potentially a study phase for some of the objectives if necessary. For example, SL on Unlicensed or FR2 have not been included in the Rel-16 study, thus can be started with a study phase if required. While the other objectives, such as CA or power saving enhancements, can start the normative work directly.

The leading WG should be RAN1, and the secondary WGs should be RAN2 and RAN4 respectively, for the whole WI, while of course can be different for each objective (e.g., RAN2 should be the leading WG for CA). RAN3 could potentially be a secondary WG for some objective(s) if needed, but the work should be very limited.

Till now we don't identify any potential interaction with SA/CT.

7 – SHARP Corporation

We think there should be a WI including at least SL CA, and potentially also co-channel co-existence.

8 – Samsung Electronics Romania

Sidelink enhancements can be WI or SI that will be dependent on which topics are finally included in the scope of Rel-18. We think that at least SI is not necessary for sidelink CA. Regarding leading WG/secondary WG(s), generally RAN1 can be considered as leading WG and RAN2/4 can be considered as secondary WG(s) although they might be different per topic.

9 – Fujitsu Limited

The work can be a WI and the item such as SL-U can have a study phase. The leading WG is RAN1, and the secondary WG is RAN2. The interaction with SA/CT can be determined when the WI becomes clearer.

10 – Sony Group Corporation

We think this can be WI but some topics like SL unlicensed operation can have a study phase. We think the leading WG is RAN1.

11 – Panasonic Corporation

We think to start from some study item could be reasonable in order to have the common understanding on what is going to be specified.

12 – Lenovo (Beijing) Ltd

Based on learning of Rel-16 NR V2X and Rel-17 Sidelink enhancement, we support a WI in Rel-18 on sidelink enhancement. RAN1 should be the leading WG and RAN2 the secondary WG.

13 – NEC Corporation

In general, considering the following candidate topics for Rel-18 sidelink enhancement, each of them may require different workload in Rel-18 study.

For the topics which have relevant legacy schemes in LTE sidelink or Rel-16/17 NR sidelink, e.g., sidelink CA and power saving, a WI should be set up for detailed standardization discussion.

On the other hand, for the new feature of sidelink communication, such as sidelink in unlicensed spectrum, as it is the first time to discuss potential schemes, a SI may be more suitable.

Therefore, we suggest to set up a dedicated SI for sidelink in unlicensed spectrum, and another WI for other topics respectively.

Besides, considering the workload of RAN 1, the topics involved in the WI should be further selected, up to 3 topics involved may be more reasonable.

14 – China Mobile E-Commerce Co.

On the work structure, we prefer that this work should be a WI. Regarding the potential areas/objectives of sidelink enhancement that listed above, we understand that companies shared diverse views on each of them; however, regarding the limited TU and workload, we cannot include all of them within the scope, and we prefer the following issues should be considered with high priority:

l Sidelink carrier aggregation

l Enhanced sidelink operation on FR2 licensed spectrum

RAN1 should be the leading WG, and RAN2/4 be the secondary WG.

15 – ZTE Wistron Telecom AB

1, This item should be a WI, at least including the following three topics, sidelink carrier aggregation, enhancements for sidelink power saving and sidelink on FR1 unlicensed spectrum. For the other two topics listed in RP-212503, if the workload and the time allows, additional two study objectives can be considered, which are (1) Enhanced sidelink operation on FR2 licensed spectrum, (2) Co-channel coexistence of LTE sidelink and NR sidelink.

2, The leading WG should be RAN1, RAN2/3/4 are the secondary WGs.

3, There may be interaction with SA2 and CT. With the sidelink carrier aggregation as an example, the allowed carrier set associated with certain sidelink service may be from SA2, etc.

16 – CEWiT

We think there should be work item including at least Sidelink carrier aggregation, power saving enhancement and co-channel coexistence of LTE and NR.

17 – Huawei Tech.(UK) Co.. Ltd

This should be a WI, as an extended enhancement from Rel-16/17 sidelink. For unlicensed, a 1-2 meeting study phase could be considered.

The leading WG should be RAN1, and secondary WGs should be RAN2 and RAN4.

We don't see a need to have interaction with SA/CT.

18 – Guangdong OPPO Mobile Telecom.

Most of the items can be started from WI. As discussed during the Aug/Sept R18 email discussion, one possible outcome for "co-channel coexistence between LTE&NR V2X" was to setup a study phase at the beginning of R18 to understand the coexistence feasibility of using semi-static configuration / separation of LTE and NR V2X resource pools or dynamic sharing of resources in overlapping resource pools in the same channel.

The leading WG for R18 feSL item should still be RAN1. The secondary WGs would include RAN2 (covering the signalling protocol aspect and packet duplication) and RAN4 (defining RF requirements for sidelink unlicensed band(s) and performance test cases).

All of the enhancement areas CA, SL-U, FR2 enh., power saving and co-channel existence are PHY layer centric, no potential interaction with SA/CT has been identified so far.

19 – Spreadtrum Communications

We think this work should be a WI. RAN 1 should be the leading WG, and RAN 2 should be the secondary WG.

20 – Beijing Xiaomi Mobile Software

- In our view the sidelink enhancement in Rel-18 should include at least sidelink unlicensed. For sidelink unlicensed topic, either a SI followed by a WI or a WI including a study phase would be OK. For topics of sidelink CA and power saving, directly starting a WI is fine. If these two topics are included in Rel-18 work scope, a WI including a study phase for sidelink unlicensed would be more preferred. Study phase would also be necessary for topics of sidelink in FR2 and LTE/NR coexistence, but we think these two topics should be deprioritized.
- The leading work group should be RAN1 and the secondary WGs should be RAN2 and RAN4.
- At current stage we do not see the impact on SA/CT.

21 – Fraunhofer HHI

In our view, Rel-18 SL enhancements should be a WI, with a possible short study phase of two meetings for new topics, e.g., SL unlicensed. The leading WG should be RAN1, with impact on RAN2 and RAN4.

22 – ROBERT BOSCH GmbH

SL enhancements, as presented above, has many topics. Some of them are straightforward and are recommended to be WI, e.g.:

- Power saving, where we need to specify WUS/GTS signaling in addition to DRX alignment (if not considered in Rel-17).
- LTE/NR V2X Co-channel coexistence, can also be WI from the beginning.
  - we are also open to study dynamic resource sharing in a short study phase (e.g., 2-3 meetings).
- CA: WI starting with Rel-15 as a basis

SI then WI, which can be for:

- SL in FR1 Unlicensed bands
- SL FR2 enhancements

23 – Intel Corporation (UK) Ltd

High-level views:

In our view the current scope identified for sidelink work in Rel.18 is broad and it does not seem feasible to accommodate all high-level objectives in a single release. We observe that prioritization/scope reduction is needed to come-up with sustainable workload/work management in Rel.18 timeframe with clear and detailed objectives. In addition, we observe that the following three objectives have overlap in terms of motivation (spectrum utilization, data rate increase / traffic offloading): 1) sidelink carrier aggregation, 2) sidelink support in unlicensed spectrum for FR1 and 3) sidelink optimizations for FR2 licensed spectrum.

Leading WG:

All objectives are RAN1-centric and therefore we assume RAN1 as a leading WG and RAN2/RAN4 as secondary WGs.

Interaction with SA/CT:

We do not see immediate impact on SA/CT for the current set of potential sidelink work directions. The need for interaction with SA/CT can be identified during discussion on solutions and thus can be decided at a later stage.

24 – Philips International B.V.

In our view the topics should at least include sidelink in unlicensed spectrum and sidelink power saving, which are very important also for the relay topic and the new ranging, personal IoT and XR topics. Other topics in order of priority should be sidelink carrier aggregation, sidelink in FR2 and co-channel coexistence of LTE/NR sidelink.

The topics of unlicensed spectrum and power saving may require a study phase. The remaining topics may go straight into normative work.

As in release 17, RAN1 could be the leading WG, and the secondary WG is RAN2. We would like to see closer cooperation though with the Sidelink Relay topic.

25 – VODAFONE Group Plc

As previously indicated, sidelink was introduced in about Rel 12 and has seen little market adoption. Hence we do not see the need for 3GPP Rel 18 time to be spent on further enhancements of sidelink, with the exception of things that enable the existing specifications to be used effectively by market sectors who have actually deployed sidelink. i.e. we support the automotive sector's request for work on the co-existence of LTE and NR sidelinks.

26 – MediaTek Inc.

Most aspects seem naturally able to go directly to a WI, but unlicensed sidelink may benefit from an initial study phase. We see all objectives as RAN1-centric, with RAN2/4 as secondary WGs. We don't see a need for SA/CT interaction.

27 – Volkswagen AG

As expressed CA, Co-channel coexistence and power saving enhancements are the most import items from an automotive point of view. At least these topics should be addressed in a WI.

28 – Apple GmbH

We think this work should be a WI, since we have clear objectives and only need specification for the proposed objectives. We think the leading WG is RAN1 and the secondary WGs are RAN2 and RAN4. So far, we have not identified interaction with SA/CT.

29 – CATT

Overall, the list of topics for this topic seems quite long, and we agree some of the topics have a huge associated workload (e.g., SL in unlicensed spectrum).

In term of WI management, we prefer to have one single sidelink item (excluding positioning and relaying), and not further divide the content into sub-WI/SI.

The list of topics that should go directly to WI include SL-CA, co-channel coexistence, and SL-FR2 licensed.

For SL-U, if there is consensus to be included in Rel-18 time frame , should first have a study phase.

RAN1 should be the leading WG. RAN2 and RAN4 can be secondary groups, potential interaction with SA/CT but this can be confirmed after the work scope is decided.

30 – Futurewei

For sidelink enhancement in Rel-18, adding additional BW will be the key to higher-capacity V2X and the other use cases. This should not be considered an optimization but rather a commercial necessity, and it is worth a bigger WI. The first three are therefore more important than the last two. The last two can be considered with some limitations to help restrict the amount of work.

Although there are a lot already on the table, defining well these objectives could work.

We think this work should be WI with a brief study period (for some topics) if necessary.

The leading group should be RAN1. RAN2 and RAN4 can be the secondary WGs.

We do not think that there would be some interaction with SA/CT. If there is any interaction needed, it should be very limited.

31 – Qualcomm CDMA Technologies

Our preference would be WI. However, we believe that some of the topics would benefit from a study phase.

The leading group for this work is RAN1 with RAN2 and RAN4 as secondary WGs where appropriate.

In general, RAN WGs should coordinate with SA2 regarding 5G ProSe enhancements.

32 – Continental Automotive GmbH

In our view, it should be a WI but the scope should be reduced, and RAN1 should remain the leading WG. Carrier Aggregation can be the main target, and FR2 aspects are also important, i.e., clarifying the assumptions for FR2 operation (CA-based with FR1) in an initial study phase would also need to be addressed.

2.1.2 Sidelink carrier aggregation

Companies are invited to provide their views on sidelink carrier aggregation which was listed in RP-212503 as non-controversial. Companies are encouraged to provide technical/commercial justification on their preferences. Additional information such as objectives and responsible working groups for each objective would also be useful for the discussions.

Feedback Form 2:

1 – Ericsson LM

In our view, the already supported use cases (public safety, V2X) justify the introduction of SL CA:

- The public safety community has requested support for operation in multiple carriers. Among other considerations, it is necessary to enable transmission and reception in different carriers, potentially belonging to different PLMNs. Support for this in ProSe was introduced in Rel-13.
- For V2X, the availability of spectrum may depend on the region. In addition, further bands may be added as the number of users and services grows. NR SL will only succeed as a technology for V2X if the specification has a framework for handling multiple carriers. In our view, CA is the appropriate framework. 5GAA as one of the representatives of the automotive community has expressed interest in this feature.

Regarding scope, we think that the following should be considered:

- LTE features:
  - Packet duplication at PDCP layer [RAN2].
  - Carrier (re-)selection [RAN2, RAN1].
  - Synchronization enhancements for multi-carrier operation [RAN1].
  - Multi-carrier operation. Transmission and reception in different carriers, potentially belonging to different PLMNs [RAN2].
- New enhancements:
  - Specific enhancements related to UC/GC [RAN1, RAN2]

        - Including SL HARQ-ACK reporting
    - Mode 1 [RAN1, RAN2]
        - New DCI format
        - Including SL HARQ-ACK reporting to the gNB
- Intra-band and inter-band CA [RAN4, RAN1, RAN2]

Besides, we think that the work should be limited in the following ways:

- Focus on licensed FR1:
    - No specific enhancements for FR2.
    - No FR1+FR2 aggregation.
- For Rel-15 functionality, Rel-15 LTE SL is the baseline. Otherwise, NR Uu CA is the baseline.
- This feature is backwards compatible in the following regards:
    - Rel-16 UEs can receive Rel-17 SL BC/GC transmissions with CA for the carriers on which they receive and transmit the corresponding SL HARQ feedback.
    - Assuming this SL functionality would co-exist in the same resource pools as Rel-16/Rel-17 functionality (e.g., no changes to reservations in SCI, etc.)

2 – LG Electronics Inc.

We think sidelink carrier aggregation is an important feature in Rel-18 and at least aggregating FR1 ITS carriers need to be supported. For the V2X operation, sidelink carrier aggregation needs to be supported for the multi-channel operation in ITS spectrum which is fragmented into multiple narrow channels; in many regions like Europe, US, Korea, the basic channel bandwidth is 10 or 20 MHz, thus a wider band operation, which was one of the main drivers of NR-V2X, can be done only by using multiple channels in the spectrum. We understand this is the main motivation 5GAA indicated in RWS-210360 where this topic was of priority #3 out of 8 topics. We agree Rel-15 LTE sidelink carrier aggregation should be the baseline, but if we need to limit the work load, we propose to take one step further by just importing those specified in Rel-15 LTE sidelink CA (i.e., SL carrier (re-)selection, synchronization of aggregated carriers, handling the limited capability, power control for simultaneous SL TX, packet duplication) to NR. If this is agreed, no work would be necessary for the identification of technical solutions and RAN2 can be the leading WG of the objectives (RAN1 and RAN4 as secondary WGs) as most of these features were captured in RAN2 specifications.

3 – Nokia France

Sidelink unlicensed is higher priority than carrier aggregation, as the ability to operate in unlicensed spectrum creates a major new opportunity to use the sidelink.

4 – DOCOMO Communications Lab.

Regarding justifications, SL CA is a feature to support more frequency resources, which is beneficial for V2X (e.g. fragmented ITS spectrum) and public safety/commercial use cases (e.g. higher throughput). But we are neutral on this topic.

Regarding objectives, if SL CA is included in Rel-18, we suggest to include mode 1 operation as well as mode 2, which will be required at least for public safety and commercial use cases.

5 – vivo Communication Technology

In our view SL over unlicensed should be given higher priority than SL CA. SL CA is helpful for achieving high data rate, especially for FR1, if multiple carriers can be assigned to SL.

Regarding the work scope, the Rel-15 LTE SL CA and NR Uu CA can be the baseline for NR SL CA, including:

- Multi-carrier operation, including data split and duplication [RAN2, RAN1]
- Carrier (re-)selection [RAN2]
- Synchronization enhancement [RAN1]
- Cross carrier scheduling/allocation [RAN1]
- Unicast and groupcast enhancements (e.g., HARQ, RLM, etc.) [RAN1, RAN2]
- RF and RRM impact for CA [RAN4, RAN2]

Considering that most of the spec impacts for CA are in RAN2, we think RAN2 should be the leading WG for CA, while RAN1 and RAN4 are the secondary WGs.

6 – SHARP Corporation

We think SL CA is of most importance among those identified during previous discussions. Rel-15 LTE SL CA should be taken as a baseline. Rel-18 SL CA should co-exist with other features in a same resource pool on a carrier, and enabling of Rel-18 SL CA feature in a UE should not degrade the performance of communications with Rel-16 and/or Rel-17 UEs, and communications between Rel-16 and/or Rel-17 UEs.

7 – Samsung Electronics Romania

Actually, LTE V2X has already supported CA feature. In this sense, NR V2X should have same function in order that NR V2X should be competitive technologies compared to LTE V2X. This would be commercial justification. Furthermore, it needs support of larger SL BW/throughput over fragmented SL spectrum. As for objectives, we think that followings should be at least under the scope.

- PC5 operation for CA (led by RAN1)
- Packet duplication (led by RAN2)

8 – Fujitsu Limited

We are open to study CA. Although we agree CA is useful for achieving higher data rate, we also think it would be more meaningful if unlicensed band can be aggregated as a CC.

9 – Sony Group Corporation

We are supportive of SL carrier aggregation to increase throughput for V2X use-case as well as a commercial use-case like home entertainments. The SL carrier aggregation should be supported in FR1 unlicensed spectrum and/or FR2 licensed spectrum if supported in Rel-18 in addition to licensed carrier and ITS carrier in FR1. A leading WG is RAN1.

10 – Lenovo (Beijing) Ltd

We prefer parallel discussion on sidelink CA with consideration of multiple scenarios, e.g., licensed/ITS carriers in FR1, licensed/ITS in FR1 and unlicensed carriers in FR1, aggregation of multiple unlicensed carriers in FR1 since CA is anyway to be discussed in the topic of sidelink transmission over unlicensed spectrum.

Regarding the scope of CA, we support sidelink synchronization enhancement to introduce new features especially for HARQ-ACK feedback enhancement and unlicensed spectrum.

11 – China Mobile E-Commerce Co.

We are supportive of studying multi-carrier enhancement in Rel-18 to support increased data rate and reliability, of which the requirement is identified by 5GAA. Aggregation of different carriers, including FR1/FR2, intra-band and inter-band, can be supported.

The enhancements specified in Rel-15 LTE-V multi-carrier operation should be the baseline, including:

l SL carrier (re-)selection (based on CBR and PSS/PBCH transmission over SL carriers),

l synchronization across aggregate carriers,

l handling limited UE capability,

l packet duplication

We are also open to further discuss the necessity to introduce new features, such as:

l HARQ feedback enhancements

l cross-carrier scheduling

l etc.

12 – NEC Corporation

As carrier aggregation feature has been defined in LTE sidelink and is also supported in NR Uu, if sidelink carrier aggregation is determined to be studied in Rel-18, it should be part of a WI.

Especially, as sidelink scheme in FR2 and unlicensed spectrum are not determined, it should be confirmed that the study of sidelink carrier aggregation in Rel-18 focuses on licensed spectrum in FR1.

13 – ZTE Wistron Telecom AB

From technical/commercial point of view, SL carrier aggregation should be introduced in Rel-18 based on the following two points:

1, Considering the carrier assignment for LTE V2X(10MHz/20MHz) on ITS band, SL carrier aggregation can be supported to let NR SL to re-farm/share the band with LTE V2X;

2, Considering the requirements listed in TS22.186, for some scenarios, extremely high data rate and reliability are required. SL carrier aggregation(both CA and packet duplication) be introduced as an effective solution.

Considering the objectives and scope, the following specific objectives can be taken for SL carrier aggregation:

Specify NR SL carrier aggregation solutions to support sidelink unicast, sidelink groupcast, and sidelink broadcast for V2X services, considering in-network coverage, out-of-network coverage, and partial network coverage.

1) synchronization among multiple carriers, including synchronization reference selection, S-SSB transmission[RAN1];

2) Carrier selection and configuration[RAN2];

3) Support on carrier aggregation and packet duplication[RAN2, RAN1];

4) Handling limited TX/RX capability[RAN1,RAN4].

14 – CEWiT

We agree Rel-15 LTE sidelink carrier aggregation should be the baseline and some additional features suggested by Ericsson LM

15 – Huawei Tech.(UK) Co.. Ltd

It was not in fact non-controversial based on the company comments, however.

SL carrier aggregation was an old topic discussed during Rel-17 scope discussion, and was not approved to be included in Rel-17 WI due to limited spectrum for V2X/SL. Thus for Rel-18, SL CA is only beneficial and necessary if there is spectrum extension from Rel-16/17, e.g. extends to unlicensed spectrum and millimeter wave spectrum, to support high data rate services. The scope should be restricted to limited combination of aggregated component carriers to reduce workload.

Objective: specify sidelink carrier aggregation

- Intra-band CA for unlicensed carriers.
- Inter-band CA for FR1 and FR2/FR2-2 carriers.

The leading and secondary WG should be RAN1 and RAN2 respectively.

If prioritization among topics is needed due to scope and TU limitation, SL unlicensed spectrum and/or on FR2 licensed spectrum should be prioritized over SL CA, since they are all targeted for high data enhancement.

16 – Guangdong OPPO Mobile Telecom.

The main purposes of enabling SL carrier aggregation (a.k.a multi-carrier operation) are to improve data rate / throughput using CA and data reliability via packet duplication. These sometimes can be seen as important for the application of V2X (data reliability) and commercial interests (e.g., high data rate AR/VR).

Sidelink multi-carrier operation should be limited to the same set of CA features that had been developed for LTE-V2X in Rel-15. That is, both carrier aggregation and packet duplication aspects should be also supported for NR sidelink in Rel-18 and reuse the same mechanisms / import from R15 LTE-V2X as much as possible (as the baseline). Other additional feedback features such as sidelink HARQ-ACK, CSI and RSRP reporting that are supported in NR sidelink (as compared to LTE-V2X) could be restricted to same-carrier operation as in R16. That is, no enhancements are needed to support SL feedback in multi-carrier operation.

The primary responsible WG could be RAN1 or even RAN2, since most of specification work are within RAN2 to support CA and packet duplication. Resource sensing and selection in PHY layer to support multi-carrier operation can be limited as we have seen in Rel-15 LTE-V2X.

17 – Spreadtrum Communications

We think carrier aggregation should be studied in R18 with high priority. And it can be supported in both licensed and unlicensed spectrum.

Carrier aggregation can facilitate the use of fragmented V2X spectrum to achieve high data rate and transmission reliability for new use cases, such as sensor information sharing, AR/VR and cloud gaming.

Potential objectives:

Taking Rel-15 LTE sidelink carrier aggregation as the baseline.

Studying the enhancement of synchronization across multiple carriers (e.g., synchronization reference selection, S-SSB transmission), carrier selection, and HARQ-ACK feedback enhancement.

18 – Beijing Xiaomi Mobile Software

Although we are supportive to include sidelink CA in rel-18, in our view sidelink unlicensed should have higher priority than sidelink CA.

Sidelink CA is beneficial by utilizing fragmented sidelink spectrum in an efficient way, and can satisfy the requirements of high throughput, high reliability sidelink communications from both V2x and commercial use cases.

Both intra-band CA and inter-band CA should be supported. All the band options including shared, ITS and unlicensed bands should be supported.

19 – Fraunhofer HHI

We are supportive of including carrier aggregation in a work item for SL Rel-18 with baseline features which were included in LTE Rel-15. This can be led by RAN1, with impact on RAN2 & RAN4.

20 – Intel Corporation (UK) Ltd

Justification

NR sidelink does not support operation with multiple sidelink carriers as defined for its counterpart LTE sidelink. This may impact flexibility of NR sidelink application for the case of fragmented spectrum limiting throughput and system reliability.

Objectives

- Sidelink multi-carrier synchronization [RAN1]
- PDCP packet duplication [RAN2]
- UE behavior with limited TX/RX capabilities in multi-carrier scenarios [RAN1, RAN2]
- Carrier selection mechanism and related resource allocation enhancements [RAN2, RAN1]

Leading working group

RAN1 - primary; RAN2/RAN4 - secondary

WI/SI considerations

Normative work can start immediately for these objectives (i.e. no need for any study phase)

21 – Philips International B.V.

We agree with Nokia and Lenovo

22 – VODAFONE Group Plc

We believe that 3GPP effort is better spent on other functionality.

23 – MediaTek Inc.

We consider SL CA to be an important objective for achieving high data rates on sidelink (as well as parity between NR and LTE sidelink offerings). We generally agree with the outline of objectives described by Intel above; RAN1 can lead with RAN2/4 as secondary groups, and no study phase is needed.

24 – Volkswagen AG

Due to a potentially fragmented ITS band in FR1, CA can be help to improve reliability and to increase data rates. Carrier aggregation in the FR1 ITS band 47 should be part of a REl-18 WI.

25 – MediaTek Inc.

As an addendum (sorry for the double post), we see that SL CA should be applicable also to licensed+unlicensed.

26 – ROBERT BOSCH GmbH

CA should support ITS band limitation, we suggest to start with Rel-15 CA. Additionally, multiplexing and PC5 CA should be considered in RAN1.

We are also encouraging considering FR1 inter-band/non-contiguous carrier aggregation. This may include a study for License and ITS bands aggregation, i.e., including Mode 1 and Mode 2.

27 – Apple GmbH

We think sidelink carrier aggregation is a necessary functionality to increase the throughput of sidelink transmissions. The existing NR sidelink can support up to 1 Gbps data rate, which is not enough to support some sidelink applications (e.g., VR based interactive service). Hence, we support the sidelink carrier aggregation as one objective of Rel-18 sidelink enhancement.

We think Rel-15 LTE sidelink carrier aggregation could be used as the baseline. The new features not specified in Rel-15 include at least sidelink feedback in sidelink carrier aggregation.

28 – Futurewei

We think sidelink carrier aggregation would have great potential for the scenarios of CA between the licensed band in FR1 or ITS spectrum and licensed band in FR2 or unlicensed band in FR1/FR2, or CA between unlicensed bands. Prioritization should be given to SL enhancement in licensed FR2 and SL unlicensed band in FR1/FR2. Currently, only carrier aggregation between ITS spectrum and licensed band in FR1 may be attractive.

If carrier aggregation is included in the WI, we suggest to implement basic features, e.g., the features in Rel-15 V2x such as multi-carrier synchronization, carrier selection, handling different transmitter and receiver capability, packet duplication, not to introduce new features not specified in Rel-15 LTE. In Rel-18, we should not intend to optimize these features which can be considered later after SL FR2 enhancement and unlicensed bands are supported.

This topic should be led by RAN1. RAN2 and RAN4 are secondary WGs.

29 – Qualcomm CDMA Technologies

Sidelink carrier aggregation is a topic of interest to us. However, if we had to order topics by priority, we'd place LTE sidelink/NR sidelink co-channel coexistence, sidelink on unlicensed spectrum, and sidelink on FR2 enhancements first.

30 – CATT

We agree sidelink carrier aggregation is the most important feature in Rel-18. It is needed to achieve higher throughput and reliability requirement for advanced V2X applications and take use of limited or fragmented

dedicated spectrum for V2X. Objectives should have multi-carrier operation in FR1 ITS , including carrier aggregation/carrier selection, and PDCP duplication. Also, this should include multi-carrier operation in FR1+FR2 after completion of FR2 related enhancement.

31 – Continental Automotive GmbH

In our view, Carrier Aggregation is a *must-have* in Rel-18. We also see this as an important enabler for scenarios where combinations between FR1, ITS, and FR2 could be used.

32 – TOYOTA Info Technology Center

We prefer to include sidelink carrier aggregation in Rel-18. It is beneficial to improve the throughput and/or reliability in case that only fragmented channels are available for some regions.

2.1.3 Enhancement to support sidelink on FR1 unlicensed spectrum

Companies are invited to provide their views on enhancement to support sidelink on FR1 unlicensed spectrum which was listed in RP-212503 as non-controversial. Companies are encouraged to provide technical/commercial justification on their preferences. Additional information such as objectives and responsible working groups for each objective would also be useful for the discussions.

Feedback Form 3:

1 – Ericsson LM

In our view, this is the most important feature under discussion as it opens many new possibilities for NR SL deployment. We think that the most prominent driving use cases are wearables and gaming.

Regarding scope, we think that the following should be considered:

- Resource allocation [RAN1, RAN2]
  - Mode 2 with LBT
  - Mode 1 enhancements to deal with SL LBT
- PHY procedures [RAN1]
  - SL HARQ feedback (including PSFCH structure, if necessary).
- Synchronization [RAN1]
  - Including impact to PHY structures (e.g., S-SSB, PSBCH, etc.), if any.

To keep the scope and workload reasonable, we think that the work should be limited in the following ways:

- SL on unlicensed FR1 spectrum only.
- Uu operation for Mode 1 in licensed spectrum only (i.e., no NR-U for Uu)
- NR SL Rel-16 specifications are the baseline for design. No specific optimizations to support Rel-17 SL features (e.g., DRX, RA for power saving, inter-UE coordination, etc.) or any other Rel-18 SL features.
- Single-channel operation (i.e., no SL CA for channel access).

- Channel access reuses LBT categories in NR-U. Avoid new LBT categories for SL.

2 – LG Electronics Inc.

We think this topic can be considered as a lower priority because no strong demand has been received from the operators or industry while considerable work would be necessary on area which has not been studied in 3GPP. If RAN decides to work on sidelink unlicensed band in Rel-18, the plan and work scope should be carefully determined. We think this objective needs to start from a study (either a separate SI or a study phase within the general SL enhancement WI) and the minimum study scope would include building evaluation methodology to include devices coexisting in the unlicensed spectrum, PHY channel structure to address regulatory requirements (e.g., the interleaved channel structure in the frequency domain), and channel access mechanism ensuring fair channel access with other devices operating WiFi, NR-U, etc.

If RAN targets a normative work in Rel-18, the work scope should be very clear and limited to the essential functions allowing sidleink in unlicensed band with the understanding that performance compromise should be okay. Thus, other sidelink topics such as synchronization, sidelink HARQ, sidelink CSI, SL power control, congestion control, SL RLM, SL DRX, inter-UE coordination can keep Rel-16/17 specifications unless SL unlicensed band operation itself is prohibited without an enhancement. If RAN targets a study over the entire Rel-18, a wider study scope may be feasible.

Also, discussion is necessary on the detailed operation scenario to be considered in this area, and the group needs to consider several options of narrowing down the scenario if there is work load issue. We propose to consider the following possibilities: Only in-coverage scenario can be considered if there is no urgent need for the V2X and public safety. Only mode 1 can be considered if there is no time to study fair channel access in mode 2 operations (note that fair channel access is expected to be straightforward in mode 1 by reusing NR-U UL scheduling). Only single-carrier standalone unlicensed band operation can be considered (i.e., no consideration of licensed-assisted operation) with the understanding that eNB/gNB in another licensed carrier can still be used as the synchronization reference by Rel-16 specifications.

This objective will be led by RAN1 with RAN2/4 as secondary WGs. No SA/CT impact is expected.

3 – Nokia France

Sidelink unlicensed is the highest priority for sidelink enhancement, as the ability to operate in unlicensed spectrum creates a major new opportunity to use the sidelink. RAN1 would be the lead WG.

4 – DOCOMO Communications Lab.

We think this topic can be deprioritized. Probably SL CA covers the motivation.

If FR1 unlicensed spectrum is included in Rel-18 scope, objectives should be limited only to essential work i.e. channel access. In addition, topics having same/similar motivation should be dropped in this case.

5 – vivo Communication Technology

In our view SL over unlicensed should be given higher priority than SL CA. We see significant and fastest-growing market need for XR and personal IoT devices, and SL over unlicensed is the most suitable technology to enable 3GPP system in these markets, in order to acquire operation spectrum, to enable interoperation among different devices from same or different operators, and to achieve higher date rate by using larger bandwidth beyond the licensed spectrum.

Regarding the scope, the NR-U can be the starting point for SL over unlicensed, including:

- Channel access mechanism, including the impacts to the following areas [RAN1, RAN2]
    - SL sensing/resource allocation [RAN1, RAN2]

- PHY structure and procedure [RAN1]
- Synchronization enhancements [RAN1]

- CA for unlicensed only and for licensed/unlicensed operation if CA is agreed in Rel-18 [RAN2, RAN1, RAN4]
- Radio interface protocol architecture and procedures [RAN2]
- Core requirements [RAN4]

The leading WG should be RAN1, and the secondary WGs should be RAN2 and RAN4, respectively.

Further, we don't think this scope should be limited to FR1 unlicensed band. The support of SL over FR2x unlicensed band can be achieved without LBT-based channel access, i.e., supported without special optimization (i.e., similar to the support of FR2 in Rel-16 NR SL).

6 – Samsung Electronics Romania

Until now, there have not been 3GPP technologies providing sidelink over unlicensed spectrum. In that sense, we think that this feature provides new vertical technologies that hasn't been provided by existing 3GPP technologies. It could provide a chance to utilize unlicensed spectrum for sidelink, and if it can be combined with licensed/ITS band which is considered in Rel-16/17 sidelink though carrier aggregation, more spectrum bandwidth can be used for sidelink. However, standalone operation would require more TUs for specifying sidelink over unlicensed spectrum since enhancement to S-SSB to support synchronization procedure for unlicensed operation would be newly needed. So, we think that non-standalone operation can be the first step for reasonable work scope. With that, following can be considered as candidate objectives.

- [Enhancement to S-SSB to support synchronization procedure for unlicensed operation]
- Channel access procedure
- Frame structure
- Resource allocation/scheduling (based on mode 1 and mode 2)

7 – Fujitsu Limited

We think SL-U should have a higher priority. In our view, SL-U can enable more interesting applications (XR, industry IoT) towards Rel-18. We are open to limit the scope in Rel-18. At least the scope can include LBT impacts on HARQ feedback and resource allocation. If the workload is still high, we are also open to give mode 1 a higher priority over mode 2.

8 – Sony Group Corporation

We support the FR1 unlicensed operation for SL to increase throughput especially for NCIS (Network Controlled Interactive Services) use-case, e.g. commercial use-case like home entertainment including AR/VR. We think this enhancement should include both mode 1 and mode 2 sidelink. At least a stand-alone operation should be supported, and LAA could be also supported if SL carrier aggregation is supported in Rel-18. A leading WG is RAN1.

9 – Panasonic Corporation

We think this introduces new use case for the sidelink and it is useful.

10 – Lenovo (Beijing) Ltd

We support FR1 unlicensed spectrum in Rel-18 for providing high data rate for diverse deployment scenarios. The detailed operation can include only standalone unlicensed operation or both licensed assisted operation and standalone operation in Rel-18.

Regarding detailed work scope, channel access should be included anyway for unlicensed spectrum in FR1. Interlace based waveform design for PSCCH/PSSCH/PSFCH/PSBCH and resource allocation should be considered as Rel-16 NR-U did.

In addition, HARQ retransmission mechanism, COT sharing as defined in Rel-16 NR-U can be considered for Rel-18 sidelink over unlicensed spectrum.

The possible objectives from our side are listed for reference:

- Waveform design to meet OCB and PSD requirements
- SCI format design
- Physical layer procedure
- Resource allocation, UE-to-UE COT sharing, gNB initiated SL COT sharing, Channel access, Synchronization, Multi-carrier, HARQ feedback enhancement
- Protocol/procedure for service continuity
- MAC enhancement for LBT failure detection and recovery, retransmission handling for CG or multiple MAC PDUs transmission etc.
- MAC enhancement to support simultaneous Mode 1, Mode 2 i.e. gNB scheduled sidelink RA and autonomous RA schemes

11 – China Mobile E-Commerce Co.

In our views, the enhancement of SL over unlicensed spectrum and the multi-beam operation seems to achieve the same goal. From the workload point of view, we prefer to down-select between the two enhancements. As concluded in the last email discussion, the SL over unlicensed spectrum may focus on FR1 and only mode 1, while the enhanced SL operation is targeting FR2, which provides larger bandwidth, we prefer to postpone the SL-U in FR1 in the future release.

12 – NEC Corporation

Sidelink in unlicensed spectrum (SL-U) is an independent new feature and can provide additional spectrum resources for sidelink and improve data rate. We propose to study SL-U with high priority in Rel-18.

As mentioned in general views, SL-U should be studied as an independent SI in Rel-18. The target scenarios and performance requirements of SL-U should be discussed and clarified, and the structure and potential schemes may be determined in this stage.

13 – ZTE Wistron Telecom AB

To increase bandwidth for sidelink transmission and to expand SL to support more vertical industry applications, such smart home network, smart office, AR/VR gaming, logistic park management,etc, the unlicensed operation on SL is important as a objective in Rel-18.

Considering the objectives and scope, the following specific objectives can be taken for unlicensed operation on SL(SL-U):

Specify NR SL-U which is operated on unlicensed band of frequencies in FR1, and support sidelink unicast, sidelink groupcast, and sidelink broadcast for V2X services, considering in-network coverage, out-of-network coverage, and partial network coverage.

1) Support of sidelink slot structure, signals, channels[RAN1];

2) SL-U physical layer procedures;

a, Channel access mechanism(LBT design),[RAN1]

b, HARQ procedures,[RAN1, RAN2]

c, Power control[RAN1]

3) Resource allocation [RAN1, RAN2];

a, Mode A: NR SL-U scheduling by NR Uu on licensed band, NR sidelink mode 1 is the start point.

b, Mode B: Sensing and resource selection procedures based on SL-U pre-configuration and configuration by NR Uu, NR sidelink mode 2 is the start point.

4) SL-U L2/L3 protocols and signalling[RAN2];

5) UE Tx and Rx RF requirement [RAN4]

14 – CEWiT

Channel access mechanism such as SL sensing/resource allocation,

PHY structure and procedure and synchronization enhancements can be considered for FR1 unlicensed.

15 – Huawei Tech.(UK) Co.. Ltd

Given the need to support multi-Gigabit/s services, the sidelink spectrum extension needs to include the wide range of available bandwidth in unlicensed spectrum is essential, particular the FR2-2 band. It is important that a unified design framework is considered for both FR1 and FR2-2, which is similarly in Rel-16, e.g. SCS, PT-RS, are also specified.

Objective: Specify sidelink operation in unlicensed spectrum for both FR1 and FR2-2

- Physical layer structure, including potential modification on slot structure, interlaced sub-channel/RBs, etc, taking into account regulatory requirement.
- Physical layer procedure, including necessary modification on SL-HARQ/SL-CSI operation, etc., taking into account channel access procedure, i.e. LBT.
- Resource allocation, including necessary modification on mode 1 and mode 2 taking into account channel access procedure.
- Synchronization, including necessary modification on S-SSB transmission, etc, taking into account channel access procedure.

The leading and secondary WG should be RAN1 and RAN2 respectively.

16 – Guangdong OPPO Mobile Telecom.

Enabling of sidelink operation in unlicensed bands (SL-U) can be seen mainly to expand the frequency spectrum support for sidelink. So far, sidelink operations are limited within one licensed band for public safety use, and one licensed band and one ITS dedicated band for V2X use. As seen, there is no spectrum support to use sidelink for commercial usage. To expand the use of NR sidelink for commercial applications and make it widely available to almost everyone and to different vertical/industry, the most rapid way is to

make it available for the unlicensed spectrum. Please refer to our papers in RWS-210046 and RP-211811 for a list of example usage of SL-U.

The work towards enabling sidelink communication over the unlicensed spectrum can take a phase approach with most basic/essential functionalities supported in Rel-18 and further enhancements for SL-U can be developed/introduced over later releases. That is, the support of SL-U in Rel-18 could be limited to FR1 and single carrier operation only (e.g., 5 and/or 6GHz bands). Towards this goal, the essential functions that should be supported from the beginning in Rel-18 includes,

1. LBT channel access scheme including COT sharing – reuse NR-U (FBE / LBE) as the baseline.

2. Updates to frequency resource mapping due to regulation requirement (i.e., OCB, PSD) in unlicensed bands – reuse NR-U distributed mapping design as a starting point.

3. Simple update to Mode 1 and Mode 2 resource allocation, SL HARQ feedback procedure in PSFCH and SL synchronization (SL-SSB) procedure (i.e., due to dropping SL transmission when LBT failure).

   - Additional updates to SL HARQ-ACK feedback to gNB related procedure, dynamic and semi-static allocation in Mode 1.

4. No updates / changes seemed necessary for the PSCCH/PSSCH slot structure to support SL-U.

The last gap symbol in SL slot and the gap symbol before PSFCH are used for LBT.

Other enhancements that can be developed and introduced in later releases can include,

- Higher frequency support (e.g., in 60GHz band FR2-2)
- Sidelink beamforming / beam management in FR2-2 (or FR2 in general)
- CA and LAA operation (licensed/ITS + unlicensed)
- ...

17 – Spreadtrum Communications

We think FR1 unlicensed spectrum should be studied in R18 with high priority. And both mode 1 and mode 2 operation should be supported.

Potential objectives:

Studying the enhancement of synchronization signals and procedures

Studying the waveform design to meet OCB requirement and PSD limitation.

Studying the enhancement of resource allocation mechanism to deal with LBT.

Studying the enhancement of communication related physical channels/signals and procedures.

18 – Beijing Xiaomi Mobile Software

We think SL-U in FR1 should be one of the high prioirty topic in Rel-18 work scope. Sidelink operation in unlicensed band can provide more available spectrum and thus can increase the throughput of sidelink application. It is beneficial for many commercial use cases, and is also useful for V2x and public safety use cases to offload high data rate traffics. In addition to higher data rate, sidelink unlicensed can also provide much more new opportunities for deployment.

Objectives such as supporting LBT/COT operation, necessary physical layer structure and procedures enhancement to support sidelink operation in unlicensed band can be considered. Both Mode 1 and Mode 2 should be supported for sidelink unlicensed operation. Rel-16/17 NR-U design can be the baseline.

19 – Fraunhofer HHI

We think that SL unlicensed is especially important for the verticals, as it opens up opportunities to utilize the sidelink for new markets without dedicated spectrum, e.g., gaming, wearables, industrial IoT.

20 – Philips International B.V.

We agree with Nokia, Vivo, Sony, Lenovo and ZTE. Sidelink operation is very important enabler for many other topics that are likely to be part of release 18, such as ranging, personal IoT and XR.

21 – VODAFONE Group Plc

We believe that 3GPP effort is better spent on other functionality.

22 – MediaTek Inc.

As already noted, there are a lot of interesting use cases for unlicensed SL, and we consider this a high-priority objective that opens the door to commercial use cases including IIoT cases, XR, personal area networks/wearables, etc. FR1 can be prioritised, but we should also look at sub-71 GHz; ultimately, the goal should be to make sidelink available in any spectrum.

We anticipate that this would be RAN1-led with RAN2/4 as secondary.

23 – ROBERT BOSCH GmbH

We have to differentiate between sidelink in unlicensed (U-SL) for SL-positioning and U-SL for sidelink communication. We think that FR1 U-SL for sidelink communication is a suitable candidate to be studied in Rel-18, where normative phase is kept for Rel-19. We believe there are useful use case and practical application for U-SL, e.g., P-IoT and commercial use cases. The study item should focus on some selected bands and their regulations, including LBT and channel access scheme.

However, we may prioritize U-SL for SL-positioning, where we support in this case a short study phase followed by a WI, i.e., to be discussed in the positioning enhancements.

24 – Apple GmbH

We think the licensed spectrum in FR1 is not large enough to support various commercial use cases of sidelink. This justifies the support of sidelink on FR1 unlicensed spectrum. Among the objectives, we think sidelink on FR1 unlicensed spectrum is the highest priority.

The detailed work scope includes at least modified physical layer structure, modified PHY/MAC layer procedures, modified sidelink resource allocation together with channel access.

25 – Futurewei

As described in TR22.842 for Network Controlled Interactive Service (NCIS), new interactive services require frequent information exchange between users. Online gaming and AR/VR based interactive services require high-rate data exchanging among UE's. Supporting SL on unlicensed spectrum will provide a large bandwidth to satisfy the high throughput requirement for these services with a very low cost, which may not be available or feasible in the licensed FR1 band.

For sidelink in unlicensed spectrum, we prefer to prioritize the work on stand-alone operation in Rel-18 for market needs. We may consider both mode 1 and mode 2. SL-U for mode 2 is an important feature, but the workload may be high. As for detailed work scope, we prefer to focus on channel access (LBT, COT) and CSI procedure. For other topics SL resource allocation, PHY/MAC procedures, or PHY structures, we

prefer to use Rel-17 features and update them only if necessary. A brief study period may be needed on the necessity of these topics.

This topic should be led by RAN1. RAN2 is the secondary WG.

26 – CATT

We agree this can be considered as a lower priority or could postpone to further releases. As we can see no support has been received from the major operators . Also , as has been pointed out, it seems similar enhancement goals can be achieved by both SL-U , SL-CA and SL multi-beam operation, therefore it could be postpone to future releases.

27 – TOYOTA Info Technology Center

We prefer to include sidelink on FR1 unlicensed spectrum in Rel-18. It is beneficial for flexible deployment of NR sidelink in addition to ITS and licensed bands.

2.1.4 Enhanced sidelink operation on FR2 licensed spectrum

Companies are invited to provide their views on enhanced sidelink operation on FR2 licensed spectrum which was listed in RP-212503 as non-controversial. Companies are encouraged to provide technical/commercial justification on their preferences. Additional information such as objectives and responsible working groups for each objective would also be useful for the discussions.

Feedback Form 4:

1 – Ericsson LM

We would like to clarify that the topic of FR2 was controversial. What was not so controversial was that in search for a second topic (besides SL CA) for SL enhancements, it was quite clear that SL for unlicensed FR1 spectrum or SL for licensed FR2 spectrum were the topics with widest support.

The scope of this feature is quite large and demanding in terms of work:

- Study multi-antenna support [RAN1, RAN2, RAN4]
  - CSI reporting including PMI.
  - Reciprocity-based transmissions.
  - Transparent schemes for control signaling.
  - SL beamforming
- Study synchronization in FR2 [RAN1, RAN2, RAN4]
- Study support for BC/GC/UC in FR2 [RAN1, RAN2]
  - Beam-based transmissions for BC
  - Beam-based transmissions for GC (Option 2) with/without SL HARQ FB
  - Beam management for UC with/without SL HARQ FB
- Study congestion control mechanisms in FR2 [RAN1, RAN2]
- Study enhancements to Mode 1 [RAN1, RAN2]
  - CSI reporting to gNB.
- Study impact of beamed transmissions on Mode 2 [RAN1, RAN2, RAN4]

- Study SL measurements in FR2 [RAN4, RAN1]
- Study core requirements [RAN4]

Besides, we think that the work should be limited in the following ways:

- Minimize modifications to the resource allocation procedures.

2 – LG Electronics Inc.

We understand there was strong support from several operators on this area, thus we think this needs to be considered with a higher priority. We also think this work will be the basis of sidelink in FR2 unlicensed band in a future release.

We think CSI enhancement needs to be considered as the minimum scope. We understand that sidelink beam management and multi-panel management can be done within CSI framework once CSI measurement and report can include the beamforming aspects.

If the work load issue is raised, we can make an assumption that RX operation does not apply beamforming so that Rel-16/17 sensing procedure is reused. In other words, only TX beamforming will be supported in Rel-18 based on the enhanced sidelink CSI.

This objective will be led by RAN1 with RAN2/4 as secondary WGs. No SA/CT impact is expected.

3 – Nokia France

Enhancements for sidelink operation in FR2 licensed spectrum could be a second priority after sidelink unlicensed, focusing on beamforming enhancements.

4 – Verizon UK Ltd

As an operator, we want to reaffirm Verizon's position on strongly supporting sidelink operations on FR2 licensed spectrum.

5 – DOCOMO Communications Lab.

We think this topic can be deprioritized. Probably SL CA covers the motivation.

If FR2 licensed spectrum is included in Rel-18 scope, objectives should be limited only to essential work i.e. beam management perspective.

6 – vivo Communication Technology

SL over FR2 spectrum is beneficial to achieve ultra-high bandwidth demand for some use cases, such as XR or gaming. It is important to enable NR sidelink operation in the market, to compete with other technology (e.g., 802.11ay).

The potential work scope includes:

- Support of higher SCS [RAN1, RAN4, RAN2]
- Beam/panels managements and CSI enhancements [RAN1, RAN4]
- Enhancements for SL sensing/resource allocation [RAN1, RAN2]
- Synchronization enhancements [RAN1]
- FR1-assisted operation [RAN1]

- RF and RRM impact for CA [RAN4, RAN2]

The leading WG should be RAN1, and the secondary WGs should be RAN2 and RAN4, respectively.

7 – Samsung Electronics Romania

We think that this can be considered as another enabler to increase sidelink throughput. Only essential features would be needed considering reasonable work scope. In that sense, we would like to suggest the following candidate objectives.

- Sidelink beam management/operation for FR2

8 – Fujitsu Limited

We are open to study FR2 licensed. In Rel-16, there were some progress such as PT-RS for FR2. The work can be continued based on the previous achievements. Also, the scope should be limited. At least the scope can include beam management related issues.

9 – Sony Group Corporation

FR2 operation for SL could be another way to increase throughput. But if we need to prioritise either supporting sidelink on FR1 unlicensed spectrum or FR2 licensed spectrum, we prefer to support sidelink on FR1 unlicensed spectrum in Rel-18.

10 – Lenovo (Beijing) Ltd

So far for FR2 licensed spectrum, we are not sure which licensed band in FR2 can be considered for sidelink. However, after the first stage of unlicensed spectrum in FR1, it is straightforward to support unlicensed spectrum in FR2 (e.g.. 60GHz) for sidelink in next release. Hence, FR1 unlicensed spectrum should be prioritized over FR2 licensed spectrum.

11 – China Mobile E-Commerce Co.

As the rationale given by our comments on SL-U over FR1, we prefer to support the enhanced SL operation in FR2 in Rel-18. In addition, the beam management for FR2 was studied in R16 study item, but not included in the work item phase due to limited time budget, and in this sense, at least the beam management enhancement should be further included in Rel-18 in normative work.

We are supportive of and open to discuss the following enhancements:

- Beam management in FR2
- MIMO enhancement, including higher MIMO order, CSI reporting, etc.

12 – ZTE Wistron Telecom AB

On FR2, abundant frequency resources are available for evaluation and operation of sidelink. There is no doubt that it can bring performance gain on better performance (e.g., high throughput and low latency). But whether to include this item to this WI is a bit controversial, some companies showed their concerns on the WI scope. If the time allows and the workload be controlled within a reasonable range, sidelink operation on FR2 licensed spectrum can be considered in Rel-18.

In Rel-16/17, only few specification work has been done. And FR2 technologies for beam-based operation should be studied in sidelink specific scenarios, such as sidelink unicast, sidelink groupcast, and sidelink

broadcast for V2X services, and in-network coverage, out-of-network coverage, and partial network coverage of scenarios.

Considering the status above, a half year of study phase is appreciated for this item. And the objectives can be the following:

Study and specify sidelink operation on FR2 licensed spectrum, considering in-network coverage, out-of-network coverage, and partial network coverage.

1) Study the support of sidelink unicast, sidelink groupcast and sidelink broadcast.[RAN1]

2) Study beam management for sidelink unicast, sidelink groupcast and sidelink broadcast.[RAN1]

3) Study CSI acquisition for unicast[RAN1, RAN2]

4) Study beam based sensing and resource selection.[RAN1, RAN2]

5) Study carrier aggregation between FR1 and FR2.[RAN1]

6) Study sidelink L2/L3 protocols for beam based measurement and report, resource allocation on multiple carriers with difference SCS.[RAN2,RAN3]

7) Study beam based power control.[RAN1]

13 – Huawei Tech.(UK) Co.. Ltd

In Rel-16, NR sidelink in FR2 is supported by applying the design for FR1 and SL-PT-RS to the numerologies agreed for FR2 (i.e. 60kHz and 120kHz). Rel-18 can extend that with support of sidelink beam management. The design of sidelink beam management can take Uu beam management as a baseline, with necessary modification specific for sidelink operation if necessary to reduce the workload, including restriction of number of beams supported for sidelink. And sidelink beam management can be used to support sidelink operation on both FR2 licensed spectrum and FR2-2 unlicensed spectrum.

Objective: specify sidelink beam management, taking NR Uu beam management design as a baseline with changes if necessary.

The leading WG should be RAN1.

14 – Verizon UK Ltd

Regarding which licensed band in FR2 can be considered for sidelink, from our side, our RAN4 colleagues will work out the details.

15 – Guangdong OPPO Mobile Telecom.

One key enhancement topic of SL operation in FR2 is in the area of “FR1 assisted SL operation in FR2”. That is, when an operator has a FR2 carrier and does not have wide area coverage support for it (but its FR1 coverage is everywhere), the operator can still utilize its allocated FR2 spectrum for direct SL communication between two UEs by configuring and controlling the sidelink operation using its FR1 Uu carrier. Doing so, the FR2 carrier/spectrum can still be utilized without network coverage for traffic offloading and reducing communication latency when two or group of UEs are in proximity to each other. Since the FR2 carrier is in a licensed band, its usage and interference can be fully monitored and controlled by the operator for ensuring QoS requirements are met. In some scenario, when one of SL UE is out of FR1 coverage, the one still in FR1 coverage can perform data relay operation to the network.

To support this operation, most of existing sidelink configuration and mode 1 scheduling can be reused. Addition enhancement/support needed could include SL channel condition measurement and feedback reporting to the network and enhanced scheduling mechanism when SL UEs are under different gNB control.

16 – Spreadtrum Communications

We think sidelink in unlicensed band can achieve the same target with FR2 licensed spectrum. So, we don't support FR2 licensed spectrum as a high priority topic in R18.

17 – Beijing Xiaomi Mobile Software

In our view this topic should be deprioritized compared with sidelink unlicensed in FR1 spectrum.

18 – Fraunhofer HHI

In our view, enhanced SL operation in FR2 can be of lower priority and could be included in a study phase first.

19 – Philips International B.V.

We agree with Nokia, Docomo, Sony and Lenovo

20 – Intel Corporation (UK) Ltd

Justification

The use of FR2 licensed frequency bands can unleash additional opportunities for evolution of cellular sidelink technologies for both communication and positioning due to high spatial reuse. The major benefits can be expected in dense deployments with intensive traffic for direct communication with or without network control of sidelink transmissions. It can be also beneficial for emerging low-latency and bandwidth consuming applications.

Objectives

- Identification of target deployment scenarios, use cases and evaluation assumptions [RAN1]
- Beam management and enhanced resource allocation for sidelink communication support in FR2 bands [RAN1]
- CSI enhancements for sidelink communications in FR2 bands [RAN1]

Leading working group

RAN1 - primary

WI/SI considerations

Study item (for whole release)

21 – VODAFONE Group Plc

We believe that 3GPP effort is better spent on other functionality.

22 – MediaTek Inc.

We think sidelink in FR2 is important to expand the available spectrum for SL use cases (and noting that operators have expressed interest). To keep the workload manageable, objectives can prioritise beam management and MIMO enhancements (e.g. CSI enhancements, >2 layers).

We foresee RAN1 as the primary group, with RAN2/4 secondary.

23 – ROBERT BOSCH GmbH

This is a good candidate for SI phase, where beam management, MIMO, CSI enhancements for SL should be studied. If time permits, prioritized FR2 enhancements can start in Rel-18.

24 – Apple GmbH

We think the support of sidelink operation on FR2 licensed spectrum is important, since there is much more spectrum available in FR2. However, we prefer sidelink on FR1 unlicensed spectrum more than sidelink operation on FR2 licensed spectrum.

The detailed work scope includes at least sidelink beam management and sidelink coverage enhancement in FR2.

25 – Futurewei

For cyber-physical applications in vertical domains, as described in TS22.104 and TR22.832, D2D communication is beneficial for low-latency and high reliability in NPN network, e.g., a private network in an indoor factory. To avoid interfering public licensed network, the devices within the shielded product-cell may use FR2 bands (e.g., 29GHz) to conduct direct communication to each other.

Also, for the NCIS, when users are in proximity, the channel is LoS and static. Such low mobility high SNR channel condition facilitates high data rate transmission in FR2 bands.

For sidelink enhancement in FR2, we prefer to consider standalone only. First, CSI enhancement is an important topic and will be needed in FR2. We propose to include this in the objective for SL enhancement in FR2. Given the shortcomings of the Rel-16 CSI design, the CSI enhancement although focused on FR2 can be generic and used in FR1, too. Therefore, in the objective of WI, we can include a statement that FR2 SL enhancement includes CSI enhancement targeted for FR2 but can also be used by FR1. Other than CSI, beam management is a high priority item. Supporting multiple beam panels and enhanced sidelink sensing for beam monitoring and management are also important.

This topic should be led by RAN1. RAN2 and RAN 4 are the secondary WGs.

26 – Qualcomm CDMA Technologies

We support sidelink on FR2 licensed spectrum, which is an important extension to enable new (high data rate) sidelink use-cases such as NCIS. Beam management procedures and signaling should be specified, to support efficient sidelink operation in FR2, including initial beam pairing, beam maintenance, and beam failure recovery. Many aspects of these could be common for both FR2-1 and FR2-2 operation and should leverage to the extent possible existing Uu mechanisms for the same.

27 – CATT

We support this topic as we see demand from major operators for this. The benefit include some dense deployment scenario and could also solve the issue of limited available spectrum in FR1. It has been noticed beam-based operation is not supported so far therefore for sidelink to take advantage of beam operation this enhancement is need.

The objectives could be focus on sidelink beam management enhancement and multi-panel selection support.

28 – Continental Automotive GmbH

As mentioned, we consider this an important evolution of NR-sidelink, which can be initiated in Rel.18 with a study phase. High priority to start this discussion in Rel. 18.

29 – TOYOTA Info Technology Center

We prefer to include enhancements for sidelink on FR2 in Rel-18. It is beneficial for realizing high-data-rate use cases. We propose to include sidelink beam management and FR1-assisted FR2 operation, which are beneficial to overcome high path loss and blockage in FR2.

2.1.5 Enhancements for sidelink power saving

Companies are invited to provide their views on enhancements for sidelink power saving which was listed in RP-212503 as controversial. Companies are encouraged to provide technical/commercial justification on their preferences. Additional information such as objectives and responsible working groups for each objective would also be useful for the discussions.

Feedback Form 5:

1 – Ericsson LM

Power saving enhancements have been specified in Rel-17. Given this and the absence of NR SL deployments, we do not think that further work is justified. One exception worth mentioning is wake-up signalling, which was down-prioritized in Rel-17 due to lack of time.

Besides wake-up signalling, only power-related enhancements targeting efficiency, like the following ones, are necessary:

- Efficiency improvements for PHY control channels (e.g., new SCI format, long PSFCH format, new sub-channel sizes).
- Enhancements for synchronization (e.g., UL timing, SLSS enhancements)

Any potential work on this topic should be subject to the following restrictions:

- No modifications to the Mode-2 resource allocation procedures since these have been in scope for Rel-17.
- NR SL Rel-17 specifications are the baseline for design. No specific optimizations targeting other SL objectives in Rel-18 are introduced.
- This feature is backwards compatible in the following regard:
    - Assuming this SL functionality would co-exist in the same resource pools as Rel-16/Rel-17 functionality (e.g., no changes to reservations in SCI, etc.).

2 – LG Electronics Inc.

We understand that the motivation of sidelink power saving is relatively weaker (for example 5GAA indicates a priority lower than co-channel coexistence of LTE/NR V2X and sidelink CA) while quite divergent views were observed on the potential solutions. As Rel-17 is introducing several solutions for sidelink

power saving, it seems desirable to revisit this area after the industry conducts analysis on the limitation of Rel-17 solutions.

3 – Nokia France

Enhancements for sidelink operation in FR2 licensed spectrum could be a second priority after sidelink unlicensed, focusing on beamforming enhancements.

4 – DOCOMO Communications Lab.

Rel-17 SL improves power saving performance, so we do not see need to work further in Rel-18. Before including this aspect in Rel-18 scope, why further enhancement is needed should be clarified sufficiently.

5 – vivo Communication Technology

Energy efficiency is an important way to combat climate change. 3GPP has been spent quite a lot of efforts to develop power saving mechanisms for DL and UL, and should not stop such efforts for SL. The Rel-17 work is only a start but should never be an end. Noted that the Rel-17 work focus on the medium-class device (with power class of 23 dBm) and limited scenarios such as V2P, but even not considers the case of communications between two power-limited devices. Thus, further power saving mechanisms are essential, e.g., for personal IoT devices which are usually less rugged, most highly battery constrained, and usually constrained by the physical dimension limitations.

The potential work scope includes:

- PA-less/VLP devices [RAN4, RAN1, RAN2]
- Power efficiency for PHY channels (e.g., PSFCH, SCI, etc.) [RAN1]
- SL wake-up signaling [RAN1, RAN2]

The leading WG should be RAN1, and the secondary WGs should be RAN4 and RAN2, respectively.

6 – Samsung Electronics Romania

We still do not see that Rel-18 sidelink power saving is necessary on top of ongoing Rel-17 sidelink features (including potential power saving technologies). Considering that we should make reasonable work scope and there are many candidate topics that have been suggested for sidelink power saving, it should be deprioritized.

7 – Fujitsu Limited

We do not see the urgent need to further study power saving since it has been standardized in Rel-17. Before studying it, the necessity better be highlighted and clarified.

8 – Sony Group Corporation

The Rel-17 UE power saving is not enough for power constrained devices such as sensors and wearables where sidelink would be helpful using low Tx power and low coverage. To further reduce a power consumption for especially commercial use-case, we think at least WUS/GTS in SL and BWP adaptation should be supported in Rel-18. A leading WG is RAN1.

9 – Lenovo (Beijing) Ltd

Based on Rel-17 learning, we don't see strong need to enhance power saving in next release. Considering there are several high prioritized topics like sidelink CA, unlicensed sidelink or FR2 licensed spectrum, we prefer to deprioritized the power saving issue.

10 – China Mobile E-Commerce Co.

In our views, the power saving mechanisms specified in Rel-17 including partial sensing/random resource selection and SL DRX seem sufficient for the power saving requirement. Further enhancements such as WUS/GTS is more like an optimization, and can be considered as low priority objective.

11 – NEC Corporation

The power saving relevant schemes of sidelink communication are still under discussing in RAN 1, if there are remaining issues that cannot be completed in Rel-17 WI, it may be further studied in Rel-18 and be part of a WI.

12 – ZTE Wistron Telecom AB

It is important to further study the power saving mechanism in Rel-18 to support the sidelink devices with battery constraints. Actually, Rel-17 is the first release to discuss the power saving in NR sidelink, only basic SL DRX is supported and it is far from satisfactory. In Rel-18, the following objectives can be included,

1) Support wake-up signalling(WUS) for sidelink.[RAN2]

2) Support narrow BWP for the sidelink devices with battery constraints.[RAN1, RAN2]

13 – CEWiT

Rel 17 already discussed Power saving in resource allocation method. For Rel 18 power saving can be targeted in control channel procedures and synchronization.

14 – Guangdong OPPO Mobile Telecom.

To better support VRUs, public safety terminals and commercial devices, further enhancements in the area of power saving is always desirable. One key topic that was deprioritized in power saving in R17 was wake-up and go-to-sleep signaling when sidelink DRX is in used. However, in our view, we should first focus on introducing new functionalities/features for sidelink in R18 such as SL-U so that the use of sidelink can be expanded to wider applications, industries and verticals.

15 – Guangdong OPPO Mobile Telecom.

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16 – Spreadtrum Communications

We think further enhancement of power saving for the devices with limited battery power is important. Considering the workload, this topic can be studied with lower priority. In this topic, UE-scheduling-UE, WUS and flexible BWP can be studied in R18.

17 – Beijing Xiaomi Mobile Software

For many use cases including V2P and commercial use cases, power saving is one of most important features which should be consistently enhanced. The objectives can include sidelink wake up signal design and flexible BWP adaptation.

18 – Huawei Tech.(UK) Co.. Ltd

Rel-17 WI already focuses on power saving enhancement, including SL-DRX and power saving resource allocation schemes (partial sensing and random resource selection). And Rel-17 power saving mechanism specification is still ongoing, whether it can satisfy the key Rel-18 scenarios can be further evaluated after the design is completed. We can discuss R18 enhancements for sidelink power saving later.

19 – Fraunhofer HHI

We believe that this needs to be addressed for the new use cases introduced in Rel-18, especially regarding new services introduced in SL unlicensed, which could benefit from wake-up (WUS) and go-to-sleep signaling or location-based power saving.

20 – Philips International B.V.

We agree with Vivo, Sony and ZTE. Further power saving enhancements are very important for us (e.g. for wearable devices).

21 – Intel Corporation (UK) Ltd

Justification

Further UE power saving can be achieved for sidelink communication if a UE can utilize reduced BW for transmission/reception and adapt amount of required BW from transmission and reception perspective. Sidelink wake-up signal can be introduced to further gain in UE power saving. This feature can be applicable to battery limited UEs (e.g., VRUs, etc.)

Objectives

- Wake-up signal support (on Uu/PC5) for power efficient sidelink communication [RAN1]
- UE behavior for sidelink communication with TX/RX bandwidth adaptation in sidelink resource pool [RAN1, RAN2]

Leading working group

RAN1 - primary; RAN2/RAN4 – secondary

WI/SI considerations

Normative work can start immediately for these objectives (i.e., no need for any study phase)

22 – VODAFONE Group Plc

We believe that 3GPP effort is better spent on other functionality.

23 – MediaTek Inc.

It's true as noted by several companies that Rel-17 already discussed SL power saving, but some aspects (e.g. WUS) were dropped from Rel-17 due to time limitations, and we see benefit in continuing with the power-saving effort as the set of sidelink use cases expands. E.g., if we enable PAN operations with wearables and similar personal devices, we will encounter devices operating on sidelink with extreme battery constraints, which were not considered in Rel-17. So we would prefer to specify at least WUS in Rel-18.

24 – ROBERT BOSCH GmbH

In our view, Rel-17 introduces only some basic functionalities for SL power saving, i.e., so far partial sensing and touching upon DRX. However, further power saving enhancements for sidelink are definitely needed for automotive and commercial use cases.

From automotive point of view, we believe that 5GAA prioritized sidelink power saving (being at the 4th position); the main motivation was:

- Automated valet parking (AVP) and tolling services where both requires SL WUS/GTS
- Further enhancements of advanced VRU use cases

For other commercial use cases and devices with very limited batteries, more enhancements (on the top of Rel-17) are still needed. E.g., further enhanced aspects like BW adaptation, DRX alignment, and WUS/GTS need to be considered.

For power saving, we recommend starting with a WI and specify the following:

- WUS/GTS support for Sidelink [RAN1]
- TX/RX bandwidth adaption for sidelink power saving [RAN1, RAN2]
- DRX alignment [RAN1, RAN2]
- [note] Ensure backward compatibility between power saving Rel-18 UEs and Rel-17/16 UEs (at least in the same resource pool)

[note] supporting the comment by Ericsson.

25 – Apple GmbH

We think sidelink power saving functionality is important for commercial use cases. Although Rel-17 sidelink enhancement already specifies mode 2 resource allocation with power saving and sidelink DRX, we think additional power saving functionalities may be beneficial. The detailed work scope may be restricted to sidelink physical layer wake-up signal and go-to-sleep signal design.

26 – Futurewei

Sidelink power saving has been considered in Rel-17 with partial sensing and DRX, which is sufficient for the power saving purpose. The market needs for addition power saving in SL are small. The only topic under power saving item that can be considered for Rel-18 is UE-Scheduling-UE. The work can reuse, if appropriate, any mechanisms and signaling developed for inter-UE coordination scheme 1 or 2 in Rel-17. The objectives for UE-scheduling-UE we considered are not for power saving but mainly for improving the system reliability and reducing the latency, i.e., for the URLLC purpose that is demanded in vertical applications such as cyber-physical applications and NCIS.

For this topic, RAN1 is the leading WG, and RAN2 is the secondary WG.

27 – Qualcomm CDMA Technologies

SL DRX is being introduced in Rel-17. In order to enable further UE power savings and to avoid waking up UEs unnecessarily, SL WUS/GTS should be considered for sidelink in Rel-18.
This is particularly important for consumer and IOT/redcap use cases especially since the SL DRX configuration is transmitter centric. Hence, one UE might need to wake up at different times according to different DRX configurations set by different Tx UEs even in the absence of any traffic.

28 – CATT

We agree with majority views from operator that Rel-17 SL already spent on power saving enhancement, therefore we do not see the need to immediately start the another power saving work in rel-18. If in the future we see the any further need to improve on top of rel-17 work, we can consider this.

29 – Continental Automotive GmbH

This was already addressed in Rel. 17. Given that other aspects, such as Carrier Aggregation and FR2 are, in our view, the mandatory evolutions of NR-sidelink, we prefer to down-prioritizing power saving in Rel. 18.

2.1.6 Co-channel coexistence of LTE sidelink and NR sidelink

Companies are invited to provide their views on co-channel coexistence of LTE sidelink and NR sidelink which was listed in RP-212503 as controversial. Companies are encouraged to provide technical/commercial justification on their preferences. Additional information such as objectives and responsible working groups for each objective would also be useful for the discussions.

Feedback Form 6:

1 – Ericsson LM

As one representative of the automotive industry, 5GAA has identified this as a topic of high importance. We believe that it is motivated by real deployment plans in many regions in which both the LTE SL and the NR SL will be used to serve V2X services. It is therefore desirable to have proper coexistence support in the specifications. In our view, the existing functionality (part of the NR Rel-16 SL specifications) is insufficient.

Two alternatives were discussed earlier:

- Alt 1: Resource pool separation between the two RATs.
- Alt 2: Dynamic resource sharing using overlapping resource pools between the two RATs.

Although we think that Alt. 2 is the most interesting one, we would be fine with working on both them. We think that this work should only target the NR SL specifications, with the only exception of having the possibility to define some new LTE SL configurations (e.g., for resource pools)

2 – LG Electronics Inc.

We think co-channel coexistence of LTE sidelink and NR sidelink is an important feature in Rel-18, in particular for V2X (we note this topic was of priority #2 out of 8 topics in the 5GAA input). In some regions like Europe, ITS technologies are required to coexist with each other in the 5.9 GHz ITS spectrum. 3GPP has been assuming that 3GPP V2X technologies would not be required to coexist with non-3GPP V2X technologies in the same carrier at a given time, which is also a basis on the relevant work in the ITS domain. With this situation, not being able to support co-channel coexistence inside 3GPP V2X technologies would mean that LTE and NR V2X should also separate in a (semi-)static manner. This would be problematic when V2X technology evolution is considered because it might imply further spectrum fragmentation inside 3GPP V2X technologies in contrast to the non-3GPP V2X technology family where dynamic channel sharing is supported between the legacy and evolved technologies. So we think this is an essential feature in Rel-18 in order to secure NR V2X spectrum in some regions. In addition, this feature will allow smooth migration from LTE V2X to NR V2X in a long term when most vehicles in the streets are equipped with both.

RAN discussed two alternatives to achieve co-channel coexistence, but we think "Alt 2 Dynamic resource sharing using overlapping resource pools between the two RATs" is necessary as LTE V2X resource pool by default spans the entire time/frequency resources of a channel in ETSI and SAE standards, i.e., no resources remain in the channel for the NR V2X resource pool. As Alt 2 would require information obtained from LTE SCI for NR operations, the in-device coexistence framework defined in Rel-16 can be reused as much as possible; in other words, this operation can be limited to a device which is equipped with both LTE sidelink module and NR sidelink mode and information is exchanged between the two modules similarly to Rel-16 specifications.

We think RAN1 will be the leading WG of this objective.

3 – Nokia France

We see the preferred mode of sidelink operation being separate carriers for LTE and NR, both for performance and complexity reasons, and we hope that additional ITS spectrum will be allocated in areas where this is currently difficult. Hence we believe the priority for coex work in Rel-18 needs further discussion.

4 – DOCOMO Communications Lab.

Regarding justifications, we think motivation is clear as coexistence of NR-SL and LTE-SL within quite limited ITS spectrum. Resource pool configurations with separate resources can work, but latency/reliability/throughput performance will degrade. Resource sharing will achieve much better performance.

Regarding objectives, Alt 2 should be focused on. We think Alt 1 is already supported.

5 – Samsung Electronics Romania

We think that the coexistence of LTE sidelink and NR sidelink sidelink has been supported since Rel-16 SL based on not only semi-static resource configuration (as long-term TDM solution) and but also dynamic prioritization (as short-term TDM solution) in case where

- 1) Transmissions from both RATs are overlapped each other in time domain and
- 2) Receptions from both RATs are overlapped each other in time domain and
- 3) Transmission from one RAT and reception from another RAT are overlapped each other in time domain

Besides, any dynamic solution introduced in Rel-18, with only benefit Rel-18 NR UEs, it will not benefit Rel-16 and Rel-17 NR UEs, whereas semi-static resource configuration can benefit UEs across all releases. There is no intention to change the LTE SL UEs, so any dynamic solution introduced in Rel-18 would make

the NR SL UEs avoid resources used by LTE SL UEs, making less resource available for NR SL UEs which brings disadvantage to NR SL over LTE SL.

6 – Fujitsu Limited

Based on the previous discussions, the coexistence seems to be a kind of in-device coexistence. In that case, some issues could be just up to implementation. We are open to further discuss the necessity and priority.

7 – Sony Group Corporation

We are supportive of the work on co-existence of LTE V2X and NR V2X to support a dynamic resource sharing using overlapping resource pools between them considering the market needs from 5GAA. We think the scope should be focused on ITS band. A leading WG is RAN1.

8 – Panasonic Corporation

We agree to study both two approaches as described by Ericsson.

- Alt 1: Resource pool separation between the two RATs.
- Alt 2: Dynamic resource sharing using overlapping resource pools between the two RATs.

9 – Lenovo (Beijing) Ltd

We support using dynamic resource sharing on overlapping resource pools between the two RATs since this can provide more flexibility and maximize resource utilization efficiency compared with semi-static resource pool separation between LTE and NR. We think the specified methods in Rel-15/16 DSS can be reused here as the starting point so as to minimize the standard effort.

10 – China Mobile E-Commerce Co.

We still hold our thoughts that the co-channel co-existence of LTE-V and NR-V is a regional issue. In addition, during the previous email discussion, two alternatives were identified to solve the potential problem, and we believe that Alt. 1, where resource pool separation between the two RATs, is the most simple and straightforward method, which has little specification impact. In such sense, we think that this enhancement should be treated as low priority.

11 – NEC Corporation

In Rel-16 NR sidelink, basic co-existence scheme of LTE V2X and NR V2X have been supported. Further enhancement of the co-existence may be applied to some special cases, while more discussions are needed and it may introduce complicated scheme.

Considering the workload of meeting, this topic should be with low priority.

12 – ZTE Wistron Telecom AB

In Rel-16/17, an implementation solution for co-channel coexistence of LTE sidelink and NR sidelink is already supported by semi static resource pools separation between the two RATs. Whether to further enable a more flexible function seems not a critical requirement. But considering the request from the automotive industry (5GAA), dynamic resource pool sharing between the two RATs can be considered if the time allows. To enable this feature/function, a study phase can be assigned for this item with following objectives:

1) Evaluation and simulation the gain of semi-static and dynamic schemes.[RAN1]

2) Evaluation the impact on Rel-16/17 sidelink devices in a sharing resource pool.[RAN1, RAN2]

3) Study the procedure and configuration for resource pool sharing. [RAN2, RAN1]

4) Study the mechanism of sensing and resource selection in Mode 2.[RAN2]

5) Study the feasibility of pool sharing between Rel-18 sidelink devices in mode 1/2 and Rel-16/17 sidelink devices which is in mode 2/1 separately.[RAN1]

13 – CEWiT

We are open to discuss coexistence of LTE side-link and NR side-link with following topics,

1. Resource pool separation between the two RATs.
2. Dynamic resource sharing using overlapping resource pools between the two RATs.

14 – Huawei Tech.(UK) Co.. Ltd

Given the needs from 5GAA, the co-channel coexistence of LTE sidelink and NR sidelink can be included in Rel-18 WI. But we think it is essential that we reuse NR-V design as much as possible to reduce the scope and workload. Thus we think the coexistence of LTE sidelink and NR sidelink design should be based on assumption that a Rel-18 UE supports Rel-16 in-device coexistence framework, i.e. dual-module for LTE and NR sidelink, each receiving/transmitting only their own RAT.

15 – Guangdong OPPO Mobile Telecom.

Based on the presentation and discussion of this topic in the R18 RAN workshop and the subsequent email discussions in August, it is clear the intention of this work for the coexistence between LTE V2X and NR V2X on the same carrier having overlapped resource pools is necessary for technology migration and re-farming of frequency resources on ITS carriers.

As mentioned in Section 2.1.1 (general views), one possible outcome for “co-channel coexistence between LTE&NR V2X” is to setup a study phase at the beginning of R18 to understand the coexistence feasibility of using semi-static configuration / separation of LTE and NR V2X resource pools or dynamic sharing of resources in overlapping resource pools in the same channel. We are fine with this approach. Furthermore, we think this work can be limited / done within 6 months, since the solution can be simple as we have analyzed and explained in RP-211811.

16 – Spreadtrum Communications

We are OK to study co-channel coexistence of LTE sidelink and NR sidelink. But we only support resource pool separation between the two RATs.

17 – Beijing Xiaomi Mobile Software

From our understanding, separate resource pool for different RATs has already been supported since Rel-16, and we do not see what can be further studied. To support dynamic sharing, NR V2x UEs needs to proactively avoiding interference to/from LTE UEs, since specification impact on LTE V2x is not expected. The performance of NR V2x needs to be sacrificed and it is not clear whether overall system performance benefit can be achieved by dynamic sharing. Therefore, we think at least a feasibility and benefit study is necessary for dynamic sharing between two RATs.

18 – Fraunhofer HHI

In our view, co-channel coexistence of LTE and NR is an important feature for Rel-18, with the focus on Alt 2 on dynamic resource sharing using overlapping resource pools, also addressing the market needs identified by 5GAA. This should be led by RAN1 with possible impact on RAN2.

19 – vivo Communication Technology

In our view Alt 1 is already supported from Rel-16, and can be used for co-channel coexistence. On the other hand, Alt 2 can provide better performance than Alt 1, but can only be used for UE beyond Rel-18 and supporting dynamic In-device coexistence. Even if Alt 2 is supported in Rel-18, anyway the spectrum fragmentation between LTE and NR (Rel-16/17 SL) is already there.

20 – Philips International B.V.

We are not in the automotive industry, so this topic is not important to us.

21 – Intel Corporation (UK) Ltd

Justification

For smooth and efficient evolution of sidelink cellular technologies, provisions of proper coexistence mechanisms should be in-place from very beginning, so that technologies can be used in co-channel deployment scenarios and have minimum negative impact on each other. Enabling such mechanisms can simplify technology evolution, migration and enable efficient spectrum utilization. The latter is especially important for sidelink V2X applications where amount of spectrum is very limited.

Objectives

Support of co-channel coexistence solution(s) for LTE V2X and NR V2X [RAN1, RAN4]

Leading working group

RAN1 - primary; RAN4 – secondary

WI/SI considerations

The 6-months study (or study phase) is desirable to align on assumptions and co-channel coexistence scenarios for LTE-V2X and NR-V2X sidelink

22 – VODAFONE Group Plc

We see that this work is important to support a sector that has deployed sidelink.

For effective use of the ITS frequency sub-blocks, it seems important that dynamic resource sharing using overlapping resource pools between the two sidelinks is supported.

23 – Volkswagen AG

As the the amount of LTE-V2X UE vs NR-V2X UE is expected to be dynamic in a certain area or over time. Therefore a dynamic ressource sharing might be a promising approach to ensure an efficient use of spectrum. A study phase may be appropriate but the target should be finalized WI in REL-18.

24 – MediaTek Inc.

We think this can be handled by Alt. 1 without spec impact, so we don't see work in this area as a high priority in Rel-18.

25 – Apple GmbH

The ITS band is shared between LTE V2X and NR V2X, leading to the co-channel coexistence issue. Hence, this functionality is important for V2X use cases.

Here, we prefer dynamic resource sharing using overlapping resource pools between the two RATs to largely utilize the ITS band. We assume there is no change to LTE sidelink. The resource allocation scheme of NR sidelink mode 2 UE could be enhanced.

26 – ROBERT BOSCH GmbH

LTE/NR V2X coexistence is an essential topic for automotive, especially for some regions where C-V2X is being seriously considered with such a limited ITS configuration. We also believe that LTE/NR coexistence should not be a very lengthy topic. Resource pool separation could be one simple solution (e.g., after involving RAN4).

However, we are also open to study dynamic resource sharing in a short study phase (e.g., in 2 meetings).

27 – Futurewei

This is the 2nd topic in the list of high priority topics from 5GAA. However, the demand of this feature is regional, i.e., in Europe. There is no market demand in the regions or countries where the spectrum is separated. As such, this may be considered a lower priority for optimization and if included the scope should be narrow.

Two alternative schemes were discussed in RAN#93-e R18 prep discussions, i.e., alt 1 Resource pool separation between the two RATs and alt 2 Dynamic resource sharing using overlapping resource pools between the two RATs. If it is included in Rel-18 WI, a brief study period is needed to confirm whether the performance for alt 1 based on existing spec is sufficient to meet the requirement of 5GAA. We do not need to further consider alt 2 if alt 1 is good enough.

For the performance study of alt 1 based on the existing specs, the work should be led by RAN4.

For further work on alt 2, the topic can be led by RAN1. RAN4 and RAN2 are the secondary WGs.

28 – Qualcomm CDMA Technologies

The ability for NR sidelink to coexist with LTE sidelink in the shame channel is critical to the commercial success of NR V2X, particularly due to the limited available ITS spectrum, as indicated in the contribution from 5GAA. There are two aspects enabled by dynamic co-existence that cannot be satisfied using semi-static coexistence.

The first is that there are existing LTE V2X channels with defined pre-configurations, which cannot be changed to accommodate semi-static coexistence. Therefore, dynamic coexistence is the only way to deploy NR sidelink in these channels.

The second is to gradually enable the transition and shift spectrum use from LTE sidelink to NR sidelink as more devices become NR sidelink capable, in order to benefit from the enhanced efficiency and reliability of NR sidelink. This, again, requires dynamic coexistence since resource pre-configuration cannot be changed once deployed.

In terms of implementation, dynamic coexistence can be enabled at the most basic level by reporting some information from the LTE sidelink module to the NR sidelink module, similar to Release-16 in-device coexistence. Additional enhancements are also possible.

In our view, this topic is well suited to being RAN1-led and could start with a study phase.

Objectives should include:

· Study and identify mechanisms to enable co-channel coexistence between NR sidelink and LTE sidelink, including performance and potential specification impact [RAN1].

29 – CATT

We can see there are some demand for this topic therefore we can consider it. If this work is included is in rel-18, the design principle should be No impacts to LTE-V2X and Ensuring backward compatible of R16/R17 NR-V2X. As has been discussed before, RAN need to make decision about two alternatives (Alt 1: Semi-static sharing between LTE-V2X and NR-V2X, e.g. by separate resource pool. Alt 2: Dynamic sharing between LTE-V2X and NR-V2X) first.

30 – TOYOTA Info Technology Center

We prefer to include co-channel coexistence of LTE sidelink and NR sidelink in Rel-18. Specifically, we propose to include dynamic resource sharing. This is quite beneficial for seamless technology evolution in the long term.

31 – Continental Automotive GmbH

We agree this would be an interesting feature from the technology adoption perspective. If addressed, we would suggest to have a short study phase on this to clarify which alternative should be used, or if both of them can be adopted.

2.2 Moderator summary and recommendation

2.2.1 Proposals / Observations with reference to general views

The following observations and proposal were made on general views:

Observation 1: A number of companies emphasized the need for a well defined and compact work scope for Rel-18 sidelink enhancement.

Observation 2: Need for a study item or a study phase within a work item would depend on the objective of Rel-18 sidelink enhancement. For example, there were a number of companies who indicated the need for study on FR1 unlicensed and LTE-NR sidelink coexistence.

Proposal 1: For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.

Observation 3: No strong necessity identified at this point on the need for interaction with SA/CT.

Proposal 2: For sidelink enhancement, RAN1 is the primary working group. Secondary working groups are RAN2 and RAN4.

2.2.2 Proposals / Observations with reference to sidelink CA

In general, companies provided positive comments to the support of sidelink CA in Rel-18. In Rel-17, NR sidelink is inferior to LTE sidelink in terms of data rate due to the lack of sidelink CA support. Sidelink CA was included in 5GAA's list of proposals for C-V2X in Rel-18.

Proposal 3: Specify mechanism to support NR sidelink CA operation [RAN1, RAN2, RAN4]

- Reuse LTE sidelink CA as much as possible

2.2.3 Proposals / Observations with reference to FR1 unlicensed spectrum

In general, companies provided positive comments to the support of FR1 unlicensed spectrum in Rel-18. Main motivation to support FR1 unlicensed spectrum was for new uses such as wearables and gaming. However, a number of companies expressed concerns that the work required to support this feature could be large. To address such concerns, it is proposed that only what is essential for FR1 unlicensed spectrum is included in Rel-18.

Proposal 4: Study the support of sidelink on FR1 unlicensed spectrum [RAN1, RAN2]

- Evaluation methodology for sidelink operation on unlicensed spectrum
- Sidelink channel access mechanism for unlicensed spectrum (for both mode 1, mode 2)
- Required change to NR sidelink physical channel structure to operate on unlicensed spectrum

2.2.4 Proposals / Observations with reference to FR2 licensed spectrum

Enhanced FR2 licensed spectrum operation received mixed comments from companies. Given the situation, it is proposed that enhancement for FR2 licensed spectrum operation be considered with a minimized work scope and with a lower priority. Note that FR2 sidelink has already been studied and evaluated in Rel-16. Any work in Rel-18 could leverage this previous work.

Proposal 5 (lower priority): Specify enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]

- Support sidelink beam management by enhancing existing sidelink CSI framework

2.2.5 Proposals / Observations with reference to sidelink power saving

Observation 4: Despite sidelink power saving being included in 5GAA's contribution to 3GPP, company views on whether or not to include sidelink power saving as part of Rel-18 are divided. Moderator view is to stop further discussion on this topic for Rel-18.

2.2.6 Proposals / Observations with reference to LTE-NR sidelink coexistence

LTE-NR sidelink coexistence has one of the highest priority in 5GAA's input to 3GPP Rel-18 workshop. In general, companies provided positive comments and emphasized that this feature is necessary for the commercial success of NR V2X.

Proposal 6: Study and identify mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance and potential specification impact [RAN1, RAN2, RAN4]

- Reuse the in-device coexistence framework defined in Rel-16 as much as possible

3 Intermediate Round

3.1 Collection of company views

3.1.1 General views

Companies are invited to provide their views on Proposal 1 and Proposal 2 from the initial round.

Proposal 1: For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.

Proposal 2: For sidelink enhancement, RAN1 is the primary working group. Secondary working groups are RAN2 and RAN4.

Feedback Form 7:

1 – TELECOM ITALIA S.p.A. As repeated multiple times, the market need for most of these features is not clear. In any case, the proposed scope is too large and it clearly will require a lot of resources from RAN1, 2, 3 and 4. The current scope is not acceptable (too large) and some objectives need to be removed. It would be important to evaluate the required TUs per objective and per WG. is this activity to be the main 3GPP RAN activity in Rel 18 (in terms of effort)????
2 – Nokia Denmark This can be a WI, but the number of objectives within it should be minimised. RAN1 is expected to be the lead WG, with RAN2 also impacted.
3 – Deutsche Telekom AG We agree with TIM that the market needs for many of these objectives are not clear and that the work scope seems to be too large. We suggest focussing on the objectes for which 3GPP got a clear market request from a MRP, i.e. 5GAA

4 – Ericsson LM

We are generally fine with both proposals, but we would like to understand what is meant by a study phase in Proposal 1

- For the features with a study phase, our understanding is that no normative work would be included in the WI at this point. Instead, RAN plenary would later update the WI based on the outcome of the study phases. Is this understanding correct?
- Given the number of topics to study and their scope, we think a proper study phase of at least half of Rel-18 will be necessary. The normative work can proceed after that depending on study conclusions.
- Will the outcome of the study phase be documented in a TR?

Besides this, we think that the scope resulting from all of Proposals 3, 4, 5, and 6 is too large. Further reduction is necessary.

5 – InterDigital

We support the proposals in general, but would like further clarification on study phase topic, scope and timeline.

6 – Futurewei

We support proposal 1. For the topic of SL on FR1 unlicensed, a brief study period may be needed on the necessity of sub-topics and objectives. For the co-channel coexistence of LTE sidelink and NR sidelink, if included, the performance study of co-channel coexistence based on the existing specs is needed, which should be led by RAN4.

We are fine with proposal 2. The performance study of the co-channel coexistence between LTE sidelink and NR sidelink should be led RAN4.

7 – Apple GmbH

For Proposal 1, it is unclear which subset of objectives starts with a study phase. It is better to clarify on this part.

We support Proposal 2.

8 – Continental Automotive GmbH

We are supportive to proposals 1 and 2 in general. Perhaps some refinement in terms of the time to be allocated for the study phase. Thus, with visibility of the time available for the WI, the work-scope need to be dimension accordingly.

9 – DOCOMO Communications Lab.

We agree with Ericsson, WI can be decided based on outcome of study phase. And current proposed scope below is too large. Further reduction is needed; otherwise, we will face the same situation as Rel-16/17 - i.e. poor progress.

10 – Samsung Electronics Romania

We are supportive of proposal 1 and 2. For proposal 1, we think that CA and FR2 licensed spectrum can be WI without having study phase since relevant works have been done in Rel-15/16, respectively. On the other hand, FR1 unlicensed spectrum and coexistence needs study phase. For FR1 unlicensed spectrum, 3GPP hasn't defined any evaluation assumptions and related results for sidelink over unlicensed spectrum. In this sense, at least evaluation methodology should be defined to see whether potential proposed features would have gain or not, and how much gain the feature can achieve. For coexistence, if it is included within objectives, feasibility study and performance comparison should be done before specifying one way or another one.

11 – LG Electronics Inc.

We agree with the two proposals.

12 – Qualcomm CDMA Technologies

We agree with both Proposals 1 and 2.

13 – MediaTek Inc.

We agree with P1 and P2 in general. Our understanding is that the study phase would be for FR1 unlicensed and LTE/NR SL coexistence.

14 – TOYOTA Info Technology Center

We support Proposals 1 and 2.

15 – CATT

We agree with P2. For P1, we think the need for study phase depends on the scope of this work. We may need to revisit this issue once we have reached consensus about what should be included in the scope.

16 – Asia Pacific Telecom co. Ltd

We agree both P1 & P2.

17 – Intel Corporation (UK) Ltd

In our view, study (or at least study phase) is needed for the following items: support of sidelink on FR1 unlicensed spectrum and enhanced sidelink operation on FR2 licensed spectrum, if these objectives are agreed.

Regarding working groups, in case of study for selected objectives, RAN1 and RAN2 are sufficient. If work item is agreed (including subset of objectives with study phase) RAN4 should be added.

18 – Guangdong OPPO Mobile Telecom.

We agree and supportive of both Proposal 1 and Proposal 2. As commented by some companies during the initial discussion to have a short study phase of 1 to 2 meetings at the beginning of the WI, for us it seems reasonable to have a "study and specify when feasible" approach for some specific SL enhancement topics.

19 – SHARP Corporation

Proposal 1 and Proposal 2 depend on the outcome of Proposal 3 to 6.

20 – vivo Communication Technology

In general, we support the proposal 1, but would like to clarify that it is also possible of no study phase depending on the discussion on the objectives. Maybe it can be revised as:

Proposal 1: For Rel-18 sidelink enhancement, start as a work item with *potentially* a study phase for a subset of objectives.

We support the proposal 2.

21 – ROBERT BOSCH GmbH

We agree with both proposals

22 – CAICT

We support proposal 1 and 2.

23 – ZTE Wistron Telecom AB

We support the two proposals. This can be a WI with a study phase for some of objectives. But the whole scope of all objectives should be within a reasonable range.

24 – Sony Group Corporation

We are fine with both proposals. But we need to clarify a study phase scope based on supported features in Rel-18.

25 – VODAFONE Group Plc

We agree with Telecom Italia and Deutsche Telekom.

26 – Fujitsu Limited

We support both proposals.

27 – China Mobile E-Commerce Co.

We are basically fine with Proposal 1, but with further clarifications on which topics requires a study phase. In addition, we believe that the current objectives proposed by Proposal 3 6 is too broad for TUs allocated for Rel-18 sidelink enhancement.

We are supportive of Proposal 2.

28 – Spreadtrum Communications

We agree with the two proposals.

29 – NEC Corporation

We agree on the above proposals.

In general, to keep a reasonable workload, up to 3 topics are preferred to be discussed in the WI (priority from high to low):

- SL-U with a study phase;

- Sidelink CA in FR1;
- Remaining issues of power saving that not completed in Rel-17;

30 – Transsion Holdings

In genaral, we are fine with both proposal 1 and proposal 2, but we believe that whether the study phase is needed for some objectives depends on the results of the following proposals.

31 – Beijing Xiaomi Mobile Software

We are supportive to the moderator proposals 1 and 2. Sidelink unlicensed and LTE/NR dynamic coexistence should be included in the study phase.

32 – Panasonic Corporation

We support the proposals.

33 – Philips International B.V.

We agree with the moderator

34 – Huawei Tech.(UK) Co.. Ltd

We are ok with the two proposals.

35 – Fraunhofer HHI

We are supportive of both proposals. We would also like to see more clarity on the objectives for the study phase and its duration.

36 – Lenovo (Beijing) Ltd

We are OK with the two proposals.

3.1.2 Sidelink CA

Companies are invited to provide their views on Proposal 3 from the initial round.

Proposal 3: Specify mechanism to support NR sidelink CA operation [RAN1, RAN2, RAN4]

- Reuse LTE sidelink CA as much as possible

Feedback Form 8:

1 – TELECOM ITALIA S.p.A.

the work (if pursued, see above) should identify some examples of band combinations. What is in the scope: inter-band or intra-band?

2 – Nokia Denmark

SL CA is needed due to fragmented SL spectrums and co-existence of NR and LTE SL is needed due to limited ITS/SL spectrum in some region. Can we identify a limited set of CA combinations to be addressed? This can help avoid high work load

3 – Deutsche Telekom AG

We also want to understand first which frequency bands and which CBW we discuss about ?!

From the 5GAA contribution in RWS-210360 we understand that the work should focus on the 5.9 GHz ITS band with first priority and ITS + licensed Spectrum with 2nd priority. We clearly do not see at this stage a SL CA need between licensed bands or between licensed and unlicensed bands. We should really focus on the essential parts —

4 – Ericsson LM

We are fine with the proposal, but it would be desirable to clarify which aspects of CA are specified. There are quite different views on what can be specified under the umbrella of SL CA. To avoid lengthy discussions, we propose to clarify in the WID that the following functionalities are to be specified:

- All LTE SL CA features
- Support for CL CA for UC/GC, including SL HARQ-ACK reporting
- Support for Mode 1, including SL HARQ-ACK reporting to the gNB and new DCI format(s).
- Intra-band and inter-band CA are in scope.

We think that it is also important to limit the scope and ensure backwards compatibility:

- Focus on licensed FR1:
  - No specific enhancements for FR2.
  - No FR1+FR2 aggregation
- This feature is backwards compatible in the following regards:
  - Rel-16 UEs can receive Rel-17 SL BC/GC transmissions with CA for the carriers on which they receive and transmit the corresponding SL HARQ feedback.
  - Assuming this SL functionality would co-exist in the same resource pools as Rel-16/Rel-17 functionalities (e.g., no changes to reservations in SCI, etc.)

5 – InterDigital

We agree with the proposal. Additionally, we think R18 WI should indicate a scope of FR1 intra- and inter-band CA. We prefer not to work on CA involving FR2 or SL U while these topics might be worked on parallelly in R18. Also, in our view, the R18 WI should include NR CA support for SL procedures (e.g. HARQ) not included in LTE SL CA.

6 – Futurewei

We are general ok with this proposal. However, it might be ambiguous by just stating "Reuse LTE sidelink CA as much as possible". We propose to implement the CA features only among the existing ones for LTE sidelink and not create the new features. The updated proposal is

Proposal 3: Specify mechanism to support NR sidelink CA operation *based on LTE sidelink CA operation* [RAN1, RAN2, RAN4]

- Reuse LTE sidelink CA as much as possible

7 – Apple GmbH

We are fine with the proposal in general. It is beneficial to specify the details of this objective, especially the areas which LTE sidelink CA cannot be re-used.

8 – Continental Automotive GmbH

OK, but the wording of the sub-bullet better as: LTE functionality as baseline. In order to make the scope more precise: we consider the following as priorities:

- support of Intra-band and inter-band CA,
- we would be in favor of discussing (and supporting) FR1+FR2 aggregation –> this can be one of the topics in the study phase.

9 – DOCOMO Communications Lab.

We are generally fine with this proposal, but detailed scope should be clearly mentioned as some companies mentioned above.

10 – Samsung Electronics Romania

We are supportive of proposal 3. We think that most of procedures can be reused as much as possible except for feedback channel since LTE V2X doesn't support this feature. For feedback channel, having some restriction (e.g., no cross carrier HARQ feedback) can reduce work load. Furthermore, minimizing specification efforts should be captured in the WID.

11 – LG Electronics Inc.

We generally agree with Proposal 3.

We think the current wording is a bit broad and any enhancement related for CA operation is allowed. In order to mitigate the work load in WGs, we think it would be desirable to list up what specific CA features will be specified. As we provided in the initial phase, those defined in LTE should be the minimum set (i.e., SL carrier (re-)selection, synchronization of aggregated carriers, handling the limited capability, power control for simultaneous SL TX, packet duplication), and other features beyond them can be treated with a lower priority or excluded from the WI. We think there is possibility to update the leading WG if the WID will list up the exact set of CA features to be specified.

12 – Qualcomm CDMA Technologies

In our view, Sidelink CA is a topic of interest; however, sidelink over unlicensed, sidelink over FR2, and NR-SL/LTE-SL coexistence are higher priority items. We would prefer to have those three topics prioritized ahead of sidelink CA.

13 – MediaTek Inc.

We agree to include sidelink CA, and think both intra- and inter-band scenarios should be included.

14 – TOYOTA Info Technology Center

We generally support Proposal 3. We agree with other companies to clarify a more detailed scope (e.g., intra-band/inter-band, target frequency bands).

15 – Intel Corporation (UK) Ltd

In principle, we are supportive of the proposal. Further clarifications are needed in terms of spectrum for sidelink CA. Many companies mentioned LTE sidelink CA and some companies are discussing NR sidelink CA in the context of licensed and unlicensed spectrum and mix of FR1 / FR2. We assume that in R18 NR sidelink CA work scope is limited to licensed/ITS carriers in FR1. Is that correct understanding / intention?

16 – Guangdong OPPO Mobile Telecom.

We agree the CA work done for LTE-V2X should be reused as much as possible and to be used as the baseline. As commented in the initial round, the necessity of any additional enhancement beyond what had been done in Rel-15 become questionable to achieve high data rate / throughput for NR sidelink.

17 – SHARP Corporation

We agree with the points highlighted by Ericsson.

18 – vivo Communication Technology

We understand that SL CA is a helpful feature and already supported in LTE. However, in our view to achieve higher date rate, SL over unlicensed/FR2 would be a better choice for NR, especially considering that channel bandwidth larger than LTE (20 MHz) is supported in NR. We prefer to prioritize SL over unlicensed/FR2 and further power saving over SL CA.

19 – Asia Pacific Telecom co. Ltd

(1) We support to discuss NR sidelink enhancements by considering LTE-V2X CA as the baseline. The possible band combinations for NR SL-CA should be discussed firstly.
(2) Both intra-band/inter-band scenarios should be considered.

20 – CAICT

We support proposal 3.

21 – ZTE Wistron Telecom AB

We support this proposal. We'd like to clarify that this objective should focus on a scope of FR1 intra- and inter-band sidelink CA.

22 – Sony Group Corporation

We are fine with this proposal. But we need to clarify which scope of CA is supported in Rel-18, i.e. FR1 licensed band, FR1 unlicensed band and FR2 licensed band (if supported). In Rel-18, we think inter- and intra-band CA for FR1 licensed band as a first priority, and further combination with FR1 unlicensed band as a second priority.

23 – Fujitsu Limited

We are fine with the direction. It better be clarified whether CA aggregating licensed and unlicensed bands is included or not.

24 – China Mobile E-Commerce Co.

We are supportive of sidelink CA, and limit the scope to resue LTE-V CA as much as possible. In addition, we share similar views as Ericsson and InterDigital that the scope should be focused on licensed FR1, including intra- and inter-band CA.

25 – Spreadtrum Communications

We are OK with this proposal. We also think it is better to clarify a more detailed scope.

26 – ROBERT BOSCH GmbH

SL CA is essential for automotive. We are fine with the proposal; however, it is also important to state the key issues in the draft. For example,

- both intra- and inter-band aggregation needs to be considered,
- support Mode 1 and Mode 2 CA (both licensed and unlicensed bands),
- limit the scope to FR1

27 – NEC Corporation

The study of sidelink carrier aggregation should focus on the licensed spectrum in FR1.

28 – Transsion Holdings

We are fine with this proposal. But we beleive SL-U should be prioritized over SL CA, since SL-U can also achieve high data rates.

29 – Beijing Xiaomi Mobile Software

We are fine with the moderator proposal, but we think sidelink unlicensed should be with higher priority.

30 – Panasonic Corporation

We support the proposal.

31 – Philips International B.V.

We agree with the moderator

32 – Huawei Tech.(UK) Co.. Ltd

The reuse of LTE-V principle is ok, and thus to reduce the workload.

But we emphasize that SL CA would not be beneficial if we don't have new spectrum extended from Rel-16/17, thus spectrum extension to unlicensed and mmWave spectrum is more important. Suggest to flag this proposal with **"lower priority"** compared to other topics.

33 – Fraunhofer HHI

We are in general fine with proposal 3. We would like to have more clarity on specific objectives such as support for intra-band/inter-band CA as well as on the targeted frequency bands, e.g., FR1 and/or FR2.

34 – Lenovo (Beijing) Ltd

We are generally OK with this proposal. Furthermore, it is better to explicitly show the detailed scope of sidelink CA, e.g., whether it includes FR1 unlicensed carriers, whether HARQ-ACK feedback enhancement is considered, whether cross-carrier scheduling is supported, etc. In addition, coordination with SA2 may be required for configuring UE on which sidelink services should use sidelink CA.

Based on above, we'd like to make slight change on this proposal as below:

Proposal 3: Specify mechanism to support NR sidelink carrier aggregation with LTE sidelink CA reused as baseline

- Scope of NR sidelink CA includes FR1 unlicensed carriers, HARQ-ACK feedback enhancement, cross-carrier scheduling [RAN1, RAN2, RAN4]
- Note: The work regarding NR sidelink carrier aggregation may require involvement of SA2

35 – Volkswagen AG

The most likely deployment scenario for operation in n47 is the out of coverage scenario. Therefore mode 2 definitely needs to be part of the CA work.

It is again emphasized that the NR-V2X operation in band n47 will be enhanced by CA since this band is expected to be fragmented due to the usage of LTE-V2X and other ITS technologies. Therefore the primary WI scope should be on intra-band non-contiguous CA in FR1.

3.1.3 FR1 unlicensed spectrum operation

Companies are invited to provide their views on Proposal 4 from the initial round.

Proposal 4: Study the support of sidelink on FR1 unlicensed spectrum [RAN1, RAN2]

- Evaluation methodology for sidelink operation on unlicensed spectrum
- Sidelink channel access mechanism for unlicensed spectrum (for both mode 1, mode 2)
- Required change to NR sidelink physical channel structure to operate on unlicensed spectrum

Feedback Form 9:

1 – Nokia Denmark

Sidelink unlicensed is higher priority than carrier aggregation, as the ability to operate in unlicensed spectrum creates a major new opportunity to use the sidelink.

2 – Deutsche Telekom AG

We do not see SL in unlicensed spectrum as a priority topic for Rel-18. This can be deferred until the scenarios and requirements are more clear. Especially we disagree with Nokia's comment above.

3 – Ericsson LM

We are generally fine with the proposal, but we would like to understand the timeline of the study and

the potential follow-up. We propose that the study phase spans at least half of the release and possible follow-up work depending on the study conclusions.

Regarding the contents, we are fine with the 3 bullets listed in the proposal, but we have the following comments:

- We think that it is necessary to include synchronization as well. The existing NR SL specifications rely on either GNSS or NW as synchronization sources. We believe that for unlicensed operation, neither of them can be assumed.
- We think that it is necessary to consider the PHY procedure of SL HARQ-ACK to have a functional system.

To keep the scope reasonable, we think that the following restrictions should be defined:

- Uu operation for Mode 1 in licensed spectrum only (i.e., no NR-U for Uu)
- NR SL Rel-16 specifications are the baseline for design. No specific optimizations to support Rel-17 SL features (e.g., DRX, RA for power saving, inter-UE coordination, etc.) or any other Rel-18 SL features.
- Single-channel operation (i.e., no SL CA for channel access, LBT BW equal to channel BW) in Rel-18.
- Wideband operation is not supported in Rel-18.
- As a sub-bullet to the second bullet in the proposal:
    - Channel access reuses LBT categories in NR-U. Avoid new LBT categories for SL.

4 – InterDigital

We support the proposal in principle with a suggestion to add another study topic "- Required change to NR sidelink procedures (synchronization, HARQ, CSI reporting, RLM/RLF, etc.) to operate on unlicensed spectrum. Our understanding is SL U FR1 will be included in the study phase.

5 – Futurewei

We are fine with this proposal.

6 – Apple GmbH

We think the scope of this objective could also include required change to NR sidelink physical layer procedures to operate on unlicensed spectrum.

Also, it may be clarified if the operations are supported for partial-coverage/out-of-coverage scenarios.

7 – DOCOMO Communications Lab.

We think "CA + SL-U + LTE-NR SL coex" in Rel-18 is still too large scope. CA/LTE-NR SL coex comes from market needs (according to 5GAA input), so they should be included as the highest priority. Based on this, SL-U should be deprioritized and we suggest to stop further discussion on this topic as section 3.1.5. If SL-U must be included in Rel-18 scope, sufficiently restricted scope as Ericsson's suggestion should be mentioned clearly.

8 – Samsung Electronics Romania

We are generally fine with the proposal. For objectives, we would like to modify the third bullet as follows.

- Required changes to NR sidelink physical channel structure/**procedure** to operate on unlicensed spectrum

9 – LG Electronics Inc.

We agree that the three bullet points are the minimum scope of the FR1 unlicensed spectrum operation, and if this topic is to be included in Rel-18, those beyond them should be avoided to keep work load at a manageable level. To make it clear, we suggest adding a sentence stating that Rel-16/17 NR sidelink features shall be kept unless reusing them prohibits operations on unlicensed spectrum.

We think the timeline needs to be clarified, e.g., whether this targets study over the entire release or a study phase which will be followed by normative work.

We think further clarification can be helpful for some sub-bullets: The objective for the channel access mechanism can state that fair channel access with other technologies needs to be ensured. The objective for the PHY channel structure can state that it should reuse those defined for NR-U as much as possible.

We don't agree with Ericsson on the further enhancements for synchronization and SL HARQ. We think SL-U UE will still see eNB/gNB in a licensed spectrum in most target use cases so synchronization enhancement is not essential. We also think no additional procedure is necessary for SL HARQ as channel access mechanism for PSFCH will be treated in the second sub-bullet; all other SL HARQ procedures including generation of SL HARQ-ACK, PSFCH resource determination and so on can reuse the existing spec.

10 – Qualcomm CDMA Technologies

We agree with the proposal, and it should be extended to FR2 unlicensed spectrum as well.

11 – MediaTek Inc.

We see this as quite an important objective to expand the available spectrum for high-performance sidelink. We think it should include FR2 unlicensed spectrum.

12 – TOYOTA Info Technology Center

We support Proposal 4.

13 – CATT

We can further discuss the priority of this aspect. But in term of objectives for this aspect, the following changes are preferred :

Study and identify necessary changes to NR SL Rel-16 to support of sidelink on FR1 unlicensed spectrum [RAN1, RAN2], including

− Evaluation methodology for sidelink operation on unlicensed spectrum

− Necessary sidelink channel access mechanism for unlicensed spectrum (for both mode 1, mode 2)

The start of normative work will be decided after completion of the study phase.

14 – SHARP Corporation

We don't think this is a high priority topic for Rel-18.

15 – Guangdong OPPO Mobile Telecom.

We tend to agree with the observation and the general intention from the moderator to limit the scope for the SL-U work in Rel-18 to focus on FR1 only, such that it is decoupled from any SL beam management related aspects and possibly also decoupled from the CA work. As commented in the initial round, the SL-U work in Rel-18 should mainly focus on SL channel access mechanism for the FR1 unlicensed spectrum to meet regulator's requirements in 5GHz and 6GHz, and all the accompany necessary SL structural and procedural changes to operate in the unlicensed spectrum in a standalone/single carrier manner.

Since the scope of SL-U is limited within the FR1 unlicensed spectrum and standalone operation, and there is significant amount of interest to support this in Rel-18, we suggest Proposal 4 could be updated to "study **and specify** the support of sidelink on FR1 unlicensed spectrum [RAN1, RAN2, **RAN4**]".

The study scope could be limited to evaluation methodology updates that are relevant to sidelink operation and coexistence with other RATs in the unlicensed spectrum. To carry out this study scope, 2 meetings seem necessary.

If the study scope is to include also channel access mechanism for the unlicensed spectrum (i.e., LBT schemes) and required changes to NR sidelink channel structure/resource allocation (mode 1 and 2)/procedure (HARQ), then the study should be 2 quarters.

16 – vivo Communication Technology

We are generally fine with this proposal, but we don't think the support of FR2x should be excluded. The support of SL over FR2x unlicensed band can be achieved without LBT-based channel access, i.e., supported without special optimization (similar to the support of FR2 in Rel-16 NR SL). Moreover, not only the PHY structure, but also others such as procedure/Synchronization, as well as higher layers (MAC, RRC, etc.), are required to support SL over unlicensed.

Thus we propose the following revisions:

Proposal 4: Study the support of sidelink on ~~*FR1*~~ unlicensed spectrum [RAN1, RAN2]

- Evaluation methodology for sidelink operation on unlicensed spectrum
- Sidelink channel access mechanism for unlicensed spectrum (for both mode 1, mode 2)
- Required change to NR sidelink *radio protocol* ~~*physical channel structure*~~ to operate on unlicensed spectrum
- *No FR2x specific optimization in Rel-18*

17 – Asia Pacific Telecom co. Ltd

We support P4.

18 – CAICT

We are fine with moderator's proposal 4.

19 – ZTE Wistron Telecom AB

We are generally fine with this proposal. Regarding the sub-objectives, we think the schemes for resource allocation and selection should be studied for operation on unlicensed spectrum, and NR sidelink mode 1 and mode 2 can be the baseline. So we'd like to add a bullet as follows:

- Required change to NR sidelink resource allocation/selection to operate on unlicensed spectrum

20 – Sony Group Corporation

We are fine with this proposal.

21 – Fujitsu Limited

We are generally fine with the proposal. Besides, we think "required change to sidelink HARQ" better be also included to make the unlicensed band operation complete.

22 – China Mobile E-Commerce Co.

We are fine with the proposal in general, a study phase is needed on the feasibility of further normative work.

23 – Spreadtrum Communications

We agree with this proposal.

24 – ROBERT BOSCH GmbH

We don't see SL in unlic. band is of high priority in for Rel-18. It may be only interesting for positioning.

25 – NEC Corporation

We suggest taking SL-U in the WI with higher priority, and the target scenarios, performance requirements and potential schemes of SL-U should be discussed and determined.

26 – Transsion Holdings

We are fine with this proposal in general. Regarding the third bullet, we believe that NR sidelink physical layer procedures (such as sidelink HARQ mechanism) should be enhanced in unlicensed bands.

27 – Beijing Xiaomi Mobile Software

We are generally supportive to the moderator proposal. However, besides potential impact on NR SL PHY structure, the impact on NR SL PHY procedures such as HARQ should also be included. Therefore, we suggest to revise the third bullet as:

- Required change to NR sidelink physical channel structure <u>and procedures</u> to operate on unlicensed spectrum

28 – Panasonic Corporation

We support the proposal.

29 – Philips International B.V. We agree with the moderator
30 – Huawei Tech.(UK) Co.. Ltd It seems to suggest a full "study" for Rel-18, however, the unlicensed operation is not a new topic (was introduced in Rel-16) in 3GPP, and many designs, particularly, channel access procedure, can be mostly reused. The WGs only need to identify what is necessary to be modified based on existing NR-U design to adapt for sidelink operation and then specify the detailed work. We think that a 1- or 2-meeting study phase seems sufficient. With above, we think it should change the word "study" to "study and specify" in the main bullet to clarify this. If it helps progress, the objective could also mention necessary modification over NR Uu; but this is not essential. **Proposal 4**: Study **and specify** the support of sidelink on FR1 unlicensed spectrum [RAN1, RAN2] (…) (...)
31 – Fraunhofer HHI In our view, we are supportive of the objectives listed here, however, proposal 4 should say "study and specify the support…" since we believe the normative work should begin after a short study phase. We would also like to include the study of changes required for SL HARQ and synchronization procedures.
32 – Lenovo (Beijing) Ltd We are OK with this proposal.

3.1.4 Enhanced FR2 licensed spectrum operation

Companies are invited to provide their views on Proposal 5 from the initial round.

Proposal 5 (lower priority): Specify enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]

- Support sidelink beam management by enhancing existing sidelink CSI framework

Feedback Form 10:

1 – Nokia Denmark Enhancements for sidelink operation in FR2 licensed spectrum could be a second priority after sidelink unlicensed, focusing on beamforming enhancements.
2 – Deutsche Telekom AG A topic which could be dropped from Rel-18 ... also from 5GAA there are no requirements from 5GAA
3 – Verizon UK Ltd While already reduced the scope of this topic to the minimum, may consider cross out ~~(lower priority).~~

The use cases and the strong market needs from operator's side have been well discussed (RP-212503)

4 – Ericsson LM

We are concerned with the size of the work item. As stated by the moderator, this item has only mixed support from the companies, so our preference would be to focus our efforts on topics with wider support.

If the topic is finally part of the WI, then:

- It must be with a very limited scope and it should be very clear in the WID (e.g., This objective only includes supporting SL beam management by enhancing the existing SL CSI framework).
- It must be clarified what "lower priority" means. Our understanding is that the topic will only be studied/specified after completing the other objectives (at least to a large extent). Given the overall WI size, we do not think that more than this is possible. This clarification should be explicitly stated in the WID.

As stated earlier, the topic of FR2 was barely discussed during the NR V2X SI. A study phase would be appropriate.

5 – InterDigital

We support the proposal with the scope focused on CSI framework enhancement for beam management. However, given the reasonable scope, we think it shouldn't be lower priority.

6 – Futurewei

With the CA scope reduced to the minimum, compared with the other two topics (power saving and co-channel coexistence), we do not think the SL enhancement on FR2 licensed spectrum should be considered as lower priority. We propose to remove "(lower priority)" in the proposal.

7 – Samsung Electronics Co.

We strongly support this proposal with the following reasons:

- **Market need**: There has been strong demand from major operators to expand network coverage/capacity and offload the traffic by using FR2.
- **Timeliness**: The support of FR2 in Rel-18 SL is quite important in terms of timeliness because FR2 design for Rel-18 SL will become a cornerstone for all future SL related enhancements over FR2 such as SL positioning over FR2, SL unlicensed operation over FR2 and so on. So, we believe that Rel-18 is the best time to specify SL FR2 operations.
- **Reasonable workload**: TR37.885 has well-captured evaluation methodologies for SL FR2 and TR38.885 has concluded that SL over FR2 is feasible by capturing not only evaluation results performed based on TR37.885 but also field trial results. So, we don't think that a study item is necessary for FR2 to define an evaluation methodology and to validate its feasibility. On the other hand, Rel-16 SL CSI framework supports some essential features for SL which are different from Uu CSI framework. So, we believe that in order to support SL beam management in Rel-18, enhancing existing SL CSI framework allows us to make Rel-18 SL scope manageable.

8 – Apple GmbH

We are fine with the proposal.

9 – Continental Automotive GmbH

We are fine with include it as low priority, with the understanding that some discussion about it will take place, because we see this as a must-have evolution, so sidelink support discussion should be initiated. This is very compatible with the fact that there is some input from Rel. 16, so follow-up discussion can take place.

10 – DOCOMO Communications Lab.

From scope size perspective, this work should be deprioritized, so we suggest to stop further discussion on this topic as section 3.1.5.

11 – LG Electronics Inc.

We are fine with limiting the scope to expanding sidelink CSI for sidelink beam management. We expect that the work load will be quite small as only the beam aspect needs to be added to the existing sidelink CSI framework.

12 – Qualcomm CDMA Technologies

Sidelink operation on FR2 licensed spectrum is important to enable new (high data-rate) sidelink use-cases such as NCIS. Hence, we do not agree that Proposal 5 should be lower priority. We agree with the concerns regarding the scope of sidelink work in Rel-18, and we think that SL in FR2 licensed spectrum can be included while still addressing these concerns, by leveraging Uu designs for beam management to the full extent possible. This should include enhancing the existing sidelink CSI framework as well as other changes to support efficient FR2 operation, including initial beam pairing, beam maintenance, and beam failure recovery. Further, these aspects are common to both FR2-1 and FR2-2 operation including operation in unlicensed bands. Hence the proposal should include FR2 unlicensed spectrum as well.

13 – MediaTek Inc.

This is a useful objective, and we think the scoping in the moderator's proposal is reasonable to keep from exploding the associated workload.

14 – TOYOTA Info Technology Center

We are fine with limiting the scope to CSI enhancements for beam management. Nevertheless, given the reduced scope, we propose to remove "lower priority" in the proposal.

15 – CATT

Similar view with Qualcomm that this should not be listed as lower priority.

16 – SHARP Corporation

We support this topic to be included in Rel-18. It should not be listed as low priority.

17 – Guangdong OPPO Mobile Telecom.

We are OK to start on sidelink beam management by enhancing the existing sidelink CSI framework, and we also agree with Proposal 5 that this should be of a lower priority in Rel-18.

Based on the comments received during the initial round, many had commented that this topic would be of lower priority compared to SL-U and most of this work has not been studied in Rel-16, where the sidelink CSI framework was done for the purpose of multi-layer MIMO (not beamforming). As such, it is also

necessary to start this work from a study phase to comprehend the full detailed scope and all technical components necessary to have a functional beam management for NR sidelink. It is suggested to study this for 9 months, since it is proposed to be a lower priority topic.

18 – Intel Corporation (UK) Ltd

In our view FR2 enhancements for sidelink require study or at least study phase before being specified. In addition, discussion on target scenarios is needed to have focused work direction / scope. We suggest the following changes for the main bullet:

~~Specify~~ Study and specify if needed enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]

· Identification of target deployment scenarios, use cases and evaluation assumptions [RAN1]

· ~~Support~~ Study and specify if needed sidelink beam management, CSI and resource allocation enhancements ~~by enhancing existing sidelink CSI framework~~ [RAN1]

19 – vivo Communication Technology

We are basically fine with this proposal. But technically the support of SL beam management does not have to be restricted in licensed band – it is a general feature for FR2. Thus, we prefer to revise the proposal as below:

Proposal 5 (lower priority): Specify enhanced sidelink operation on FR2 ~~*licensed*~~ spectrum [RAN1, RAN2, RAN4]

- Support sidelink beam management by enhancing existing sidelink CSI framework

20 – Asia Pacific Telecom co. Ltd

We support this topic and we suggest not to give it a low priority.

21 – CAICT

We agree SL on FR2 licensed band with a lower priority than SL CA and SL-U.

22 – ZTE Wistron Telecom AB

We are fine with this proposal.

23 – Sony Group Corporation

We are OK with this proposal as a low priority in Rel-18.

24 – Fujitsu Limited

We support the proposal.

25 – China Mobile E-Commerce Co.

We are supportive of the proposal.

26 – Spreadtrum Communications

We agree with this proposal as a low priority.

27 – ROBERT BOSCH GmbH

We are fine if it is listed as a lower priority.

28 – Transsion Holdings

We support this proposal with a note as low priority.

29 – Beijing Xiaomi Mobile Software

We agree that the objective is with lower priority. If there is concern that the whole work scope of Rel-18 sidelink is too large, this objective should be removed. In addition, as sidelink FR2 operation is not extensively studied in Rel-16 sidelink SI, a study phase would be needed if this topic is included.

30 – Panasonic Corporation

We support the proposal.

31 – Philips International B.V.

We agree with the moderator, in particular we agree with considering this topic with lower priority

32 – Huawei Tech.(UK) Co.. Ltd

We are supportive on beam-based sidelink operation.

In Rel-16, both FR1 and FR2 are supported in a common sidelink PHY structure, and with additional designs, such as numerologies, SL-PT-RS, for FR2 operation. This principle should be reused in Rel-18. The design in Rel-18 should not be confined to FR1 only. On sidelink beam management, WGs can take NR Uu beam management design as a baseline, with essential modification only for sidelink operation to reduce the workload. We think we may need to add a sub-bullet to clarify this baseline. In addition, FR2 includes both licensed and unlicensed spectrum; in Rel-17 Uu design, beam management designs for licensed and unlicensed spectrum are totally the same, so from sidelink beam management design perspective, it also applies to both. It is not needed to restrict the SL beam management for FR2 licensed spectrum only, thus the word "licensed" can be removed.

We view spectrum extension is with higher priority than SL CA on high data rate enhancement, and the "lower priority" flag needs to be removed.

Proposal 5 ~~**(lower priority)**~~: Specify enhanced sidelink operation on FR2 ~~**licensed**~~ spectrum [RAN1, RAN2, RAN4]

- Support sidelink beam management **by taking NR Uu beam management as a baseline with essential modifications, and** enhancing existing sidelink CSI framework

33 – Fraunhofer HHI

We agree with the proposal and prefer to maintain it as low priority.

34 – Lenovo (Beijing) Ltd

We are OK with this proposal.

3.1.5 Sidelink power saving

Given the views are divided on sidelink power saving, there will not be any further discussion on this issue in the final round. If there are any final comments on sidelink power saving with regards to Observation 4 from the initial round, please provide them below.

Observation 4: Despite sidelink power saving being included in 5GAA's contribution to 3GPP, company views on whether or not to include sidelink power saving as part of Rel-18 are divided. Moderator view is to stop further discussion on this topic for Rel-18.

Feedback Form 11:

1 – TELECOM ITALIA S.p.A. This is a critical feature for smartphones (Vulnerable Road User scenario)
2 – Nokia Denmark The success of SL deployment in non-V2X use cases and even in the case of VRU in V2X is dependent on the power efficiency of the SL design. As in Rel.18 several new enhancements are being introduced to the SL design, then these should also take power saving into account. We propose that power saving is an underlying assumption for each of the introduced features and that WUS/GTS is still considered.
3 – Deutsche Telekom AG We agree with TIM and refer to 5GAA's contribution in RWS-210360 that this is an important topic for VRU.
4 – Ericsson LM Although we still think that there are some interesting enhancements related to energy efficiency, we are fine with the proposal to keep the scope reasonable.
5 – InterDigital We consider further SL power saving enhancement an important topic (for VRU and wearables devices) and thus R18 topic should at least include support for DRX functionalities (led by RAN2). In addition, we prefer to include WUS/GUS topic.
6 – Futurewei We are ok to not include sidelink power saving for Rel-18.
7 – Apple GmbH We think restricted topics on sidelink power saving (e.g., sidelink wake-up signal) may be considered if the scope allows.

8 – Continental Automotive GmbH

Vulnerable Road Users is an important use case. We are also fine with covering this in the study-phase (perhaps with low priority same as FR2 aspects) to better understand whether or not the Rel. 17 will be enough in practice.

9 – DOCOMO Communications Lab.

Agree to stop further discussion on this topic. Why Rel-17 power saving is insufficient is not identified well.

10 – Samsung Electronics Romania

We are supportive of moderator's observation and view to stop further discussion on this topic.

11 – ROBERT BOSCH GmbH

We do not support this proposal and we think it might not be covering exactly the discussions above. We are also not sure whether the proposal gives a message inline with the 5GAA prioritization for sidelink power saving!

Further SL power saving is essential in Rel-18, at least, due to the lack of WUS/GTS in Rel-17 and efficient DRX. VRU and some other automotive use cases, e.g., AVP/Tolling, requires these enhancements. For example, WUS is a must for Automated Valet Parking (AVP) to work with SL as a backup link; this is a safety related requirement.

As a compromise (which is also stated by several companies above), we can agree to limit SL power saving scope to Sidelink WUS/GTS/WUR only.

Other leftovers from Rel-17, e.g., enh. SL DRX, can be discussed in the future when deemed essential.

12 – LG Electronics Inc.

We agree with the moderator view in order to manage the work load.

13 – Qualcomm CDMA Technologies

For power saving, in our view, at least SL WUS/GTS should be supported.

14 – MediaTek Inc.

We would be OK to limit the scope, but we think at least WUS should be specified in Rel-18. This was already discussed in Rel-17 but not specified, and the impact of picking it up again should be limited.

15 – CATT

We support the proposal from the moderator.

16 – SHARP Corporation

We share the observation from Moderator.

17 – Guangdong OPPO Mobile Telecom.

Given there will be limited TU/work effort can be spent on SL enhancement in Rel-18, SL power saving is not one of the high priority items. We agree and accept Observation 4 from the moderator.

18 – vivo Communication Technology

We cannot agree to exclude further power saving enhancements for SL. As we commended before this feature is very important for commercial or V2X use cases. The Rel-17 power saving mechanisms only focus on medium-class device (with power class of 23 dBm), limited scenarios such as V2P/P2V (without considers the case of communications between two power-limited devices), and limited technologies such as DRX and partial sensing (even without harmonization between them). This is only enough for V2X (VRU, etc.) and commercial use cases (wearable, glasses, home automation, etc.).

If workload is the concern, we should at least include the support of PA-less/VLP devices (i.e., power class lower than 23 dBm) for NR, whose leading WG is RAN4 and has very limit work for other WGs.

19 – Intel Corporation (UK) Ltd

Considering very broad scope of the proposed sidelink objectives on the table and the need for further scope reduction, we can accept the view from the moderator, although we are supportive of sidelink WUS/GTS and are open to consider this, if it can finally fit to the R18 scope (which is subject to further outcome of this discussion).

20 – Asia Pacific Telecom co. Ltd

Power saving may be beneficial in some NR-SL services.
We suggest at least WUS/GTS-like design should be considered in Rel-18.

21 – CAICT

We support moderator's proposal.

22 – Sony Group Corporation

We don't agree with moderator observation 4. We think this should not be excluded from further discussion. We also think the power saving enhancement for sidelink is important for VRU as well as non-V2X use-cases.

23 – ZTE Wistron Telecom AB

We share similar views with TIM and DT, this is a useful feature for smartphones. As cited by some companies, to control the scope, we also think this feature can focus on WUS for sidelink only.

24 – Fujitsu Limited

We support the proposal.

25 – Spreadtrum Communications

We agree with this proposal.

26 – China Mobile E-Commerce Co.

The power saving mechanisms specified in Rel-17 is sufficient for the power saving requirement, and this topic can be considered as low priority.

27 – NEC Corporation If there are remaining issues that cannot be completed in Rel-17 WI, they can be further studied in Rel-18 sidelink WI.
28 – Transsion Holdings We agree with this observation.
29 – Beijing Xiaomi Mobile Software We can accept moderators observation although we are supportive to include power saving objective into Rel-18 sidelink work scope.
30 – Panasonic Corporation We are ok.
31 – Philips International B.V. We do not agree with the moderator. Sidelink power saving is essentials (I.e. sidelink is not only about cars having huge batteries) and therefore should be included as part of Rel-18. It is higher priority then e.g. sidelink CA, FR2 support and co-existence, so prefer to remove some of those other topics instead.
32 – Huawei Tech.(UK) Co.. Ltd It seems that this topic is not urgent to be handled at this stage, and we can come back at least after completion of Rel-17 power saving objectives (both RAN1 and RAN2), and then evaluate on whether or not to include this topic in Rel-18.
33 – Fraunhofer HHI We think that at least WUS/GTS and location-based power saving should be supported since it can cater to enhanced power saving capabilities required for vertical markets.
34 – Lenovo (Beijing) Ltd We agree with moderator's view.

3.1.6 LTE-NR sidelink coexistence

Companies are invited to provide their views on Proposal 6 from the initial round.

Proposal 6: Study and identify mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance and potential specification impact [RAN1, RAN2, RAN4]

- Reuse the in-device coexistence framework defined in Rel-16 as much as possible

Feedback Form 12:

1 – Nokia Denmark

We support a reduced study item to further clarify the need and design scope of this solution.

2 – Deutsche Telekom AG

As the ITS spectrum is quite limited and advanced use cases will come with NR-SL the co-existence between these two 3GPP SL technologies (aka C-V2X) is essential. Reference is given to the 5GAA contribution in RWS-210360 and other publications via www.5gaa.org

3 – Ericsson LM

We are fine with the proposal but would like to understand the timeline of the study and the potential follow-up. Our view is that NR-LTE co-channel co-existence is a well-defined topic with a quite limited scope. Although the scope is much smaller, the topic will have to share TUs with the rest of objectives. Thus, we propose to follow the same timeline as for other study phases in this WI: at least half of Rel-18 for study. At that point, RAN may update the WI with corresponding objectives for normative work.

4 – InterDigital

We support the proposal.

5 – Futurewei

We think this topic should be a lower priority one. And it should be discussed after the study on the performance of co-channel coexistence based on existing spec. Further, the current wording of the proposal is for study only, which is OK for us. But if any work is to be included in rel-18, it should be ”study and if agreed specify”. We propose the following update on the proposal.

Proposal 6 ***(lower priority)***: Study and*, if agreed, specify* ~~identify~~ mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance and potential specification impact [RAN1, RAN2, RAN4]

- Reuse the in-device coexistence framework defined in Rel-16 as much as possible

6 – Apple GmbH

5GAA suggestion is on sidelink spectrum sharing between LTE sidelink and NR sidelink. It is more like a network deployment issue and the corresponding UE solution to fit in a certain network deployment.

The Rel-16 in-device coexistence framework only serves as a pre-requisite to facilitate the work, but it does not address this issue. Hence, we are not sure if the sub-bullet of the proposal is necessary.

7 – Continental Automotive GmbH

We are also supportive to this proposal. The wording is appropriate in our view.

8 – DOCOMO Communications Lab.

We support this proposal. LTE-NR SL coex on the same spectrum is required for market expansion. Also 5GAA suggests study/work on this topic.

This topic's target is to share same time/frequency resources among LTE/NR, which means inter-UE coex. Rel-16 in-device coex is intra-UE coex as the name suggests, i.e. they are different. So we do not feel the sub-bullet is necessary. That aspect can be discussed in study phase.

9 – Samsung Electronics Romania

We think that it is still quite controversial on the issue about specifying new mechanism(s) for LTE/NR coexistence, and that's why it needs study phase for the feasibility. So, we would like to suggest following aspect in the proposal.

Proposal 6: Study and **if necessary**, identify mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance and potential specification impact [RAN1, RAN2, RAN4]

- Reuse the in-device coexistence framework defined in Rel-16 as much as possible

10 – LG Electronics Inc.

We agree with this proposal. In addition, it is necessary to set a check point at which the normative work scope will be decided based on the study outcome.

11 – Qualcomm CDMA Technologies

We support the proposal.

12 – MediaTek Inc.

We are not sure that specification impact is needed for this, but it would be acceptable to have a study phase to determine if something is necessary. We agree with others that it should proceed to normative work only if deemed necessary.

13 – TOYOTA Info Technology Center

We support Proposal 6.

14 – CATT

We can support this proposal, but we think the scope can be further specific if it includes the selection of two alternatives discussed before.

15 – SHARP Corporation

We support the proposal.

16 – Guangdong OPPO Mobile Telecom.

In general, we agree with Proposal 6, but prefer to list out the two alternatives from the conclusion of the last round of email discussion so that it is clear the study scope is limited by the two alternatives. That is,

- Alt.1: Resource pool separation between the two RATs
- Alt.2: Dynamic resource sharing using overlapping resource pools between the two RATs

Additionally, we don't think RAN4 needs to be involved as these two alternatives do not involve RF requirement work in RAN4.

17 – Intel Corporation (UK) Ltd

We are supportive of the proposal from moderator.

18 – vivo Communication Technology

We don't understand why it is proposed to exclude SL power saving but include LTE-NR SL coexistence in Rel-18. Firstly, both are included in 5GAA's contribution, while additionally power saving is commented necessarily for other use cases (commercials, etc.) by other companies. Secondly, unfortunately company views on whether or not to include them in Rel-18 are divided for each of them. Then clearly, there is no reason to drop SL power saving but include LTE-NR SL coexistence in rel-18.

19 – Asia Pacific Telecom co. Ltd

We support this proposal.

20 – CAICT

We are fine to have a study on LTE-NR coexistence in R18 but lower priority than SL CA and SL-U.

21 – Sony Group Corporation

We are OK with this proposal but we should carefully check available TUs for this topic. If there is enough TUs for the sidelink enhancement, we can consider this topic as a low priority.

22 – VODAFONE Group Plc

We support this (and agree with Deutsche Telekom's comment)

23 – ZTE Wistron Telecom AB

We generally support this proposal. Considering the scope and the timeline in Rel-18, this can be considered as a secondary priority objective.

24 – Fujitsu Limited

We support the proposal.

25 – China Mobile E-Commerce Co.

We are basically fine with the propsal. If this topic is included, a study phase on necessity and feasibility is needed.

26 – ROBERT BOSCH GmbH

We support the proposal

27 – NEC Corporation

Considering the workload, the study of co-existence should be with low priority.

28 – Transsion Holdings

We are fine with this proposal.

29 – Beijing Xiaomi Mobile Software

We agree with Samsung comments to add ”if necessary”. In addition, this objective should focus on V2x use case only. Therefore we suggest to revise the main bullet of the proposal as:

Study and if necessary, identify mechanism(s) to enable co-channel coexistence for LTE ~~sidelink~~ V2x and NR ~~sidelink~~ V2x including performance and potential specification impact

30 – Panasonic Corporation

We support the proposal.

31 – Huawei Tech.(UK) Co.. Ltd

Though we see the existing resource partitioning between LTE-V and NR-V is sufficient for co-channel coexistence for LTE sidelink and NR sidelink, we are ok to study co-channel coexistence under the assumption that Rel-16 in-device coexistence framework of dual module devices is reused. During the study, further input in terms of performance and feasibility can be provided, and this may allow 3GPP to inform external organizations such as 5GAA whether existing specifications are sufficient for co-channel coexistence. With this information available, RAN can at that point decide whether or not subsequent normative work is needed in Rel-18.

Proposal 6: Study ~~**and identify**~~ mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance**, necessity,** and ~~**potential specification impact**~~ **feasibility** [RAN1, RAN2, RAN4]

32 – Fraunhofer HHI

We support the proposal.

33 – Lenovo (Beijing) Ltd

We are OK with this proposal.

34 – Volkswagen AG

Out-of-coverage mode 2 deployments are expected in band n47. Therefore mode 2 should be primarily considered. As stated, a dynamic resource sharing might be a promising approach to ensure an efficient use of spectrum.

A study phase may be appropriate but the normative phase should be finished in Rel-18.

3.2 Moderator summary and recommednations

While the views from companies are generally positive towards having a Rel-18 sidelink enhancement work item, there were some companies who did not think a Rel-18 study/work item was justified. In particular, Telecom Italia and Deutsche Telekom expressed views that the market need is unclear.

In addition, although majority of the companies were supportive of a work item in Rel-18, many of the same companies made it clear that the work scope of Rel-18 sidelink enhancement needed to be compact. To accommodate these views, the proposals from the intermediate round have been revised accordingly in the

following subsections. Companies are respectfully requested to consider this aspect when providing their views for the final round. Without a compact work scope, there might not be a Rel-18 sidelink work item.

3.2.1 Proposals / Observations with reference to general views

Proposal 1 has been modified to clarify how objectives subject to study phase will be handled. As to the necessity of a TR, moderator view is that it is not necessary. Objectives subject to a study phase can be found is follow up proposals.

Proposal 1: For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.

- For the objectives subject to a study phase, RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.

Proposal 2 (non-controversial): For sidelink enhancement, RAN1 is the primary working group. Secondary working groups are RAN2 and RAN4.

3.2.2 Proposals / Observations with reference to sidelink CA

Proposal 3 has been modified to make the work scope more compact and clear based on company comments.

Proposal 3: Specify mechanism to support NR sidelink CA operation based on LTE sidelink CA operation [RAN1, RAN2, RAN4]

- Prioritize supporting LTE sidelink CA features for NR (i.e. SL carrier (re-)selection, synchronization of aggregated carriers, handling the limited capability, power control for simultaneous SL TX, packet duplication)
- Sidelink CA operation is not support in Rel-18 for unlicensed spectrum or for FR2

3.2.3 Proposals / Observations with reference to FR1 unlicensed spectrum

Proposal 4 has been modified to make the work scope more compact and clear based on company comments. In addition, the last sentence has been added to clarify that RAN will determine whether or not to introduce specification support in RAN#98.

Proposal 4: Study the support of sidelink on FR1 unlicensed spectrum for both mode 1 and mode 2 where Uu operation for mode 1 is limited to licensed spectrum only [RAN1, RAN2, RAN4]

- Evaluation methodology for sidelink operation on unlicensed spectrum
- Sidelink channel access mechanism for unlicensed spectrum
- Required changes to NR sidelink physical channel structures and procedures to operate on unlicensed spectrum

- No specific optimizations for Rel-17 SL features (e.g., DRX, resource allocation for power saving, inter-UE coordination, etc.)

RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.

3.2.4 Proposals / Observations with reference to FR2 licensed spectrum

Proposal 5 has been modified to clarify that the work on FR2 is limited to the support of beam management.

Proposal 5: Specify enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]

- Work is limited to the support of sidelink beam management by enhancing existing sidelink CSI framework

3.2.5 Proposals / Observations with reference to sidelink power saving

It's clear the situation has not changed. No further discussions on sidelink power saving in final round.

3.2.6 Proposals / Observations with LTE-NR sidelink coexistence

Proposal 6 has been modified based on comments from companies. In addition, the last sentence has been added to clarify that RAN will determine whether or not to introduce specification support in RAN#98.

Proposal 6: Study mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance, necessity, feasibility, and potential specification impact [RAN1, RAN2, RAN4]

- Reuse the in-device coexistence framework defined in Rel-16 as much as possible

RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.

4 Final Round

4.1 Collection of company views

4.1.1 General views

Proposal 1: *For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.*

- *For the objectives subject to a study phase, RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.*

Proposal 2 (non-controversial): *For sidelink enhancement, RAN1 is the primary working group. Secondary working groups are RAN2 and RAN4.*

Companies are invited to provide their views with respect to the above proposal 1 and proposal 2.

Feedback Form 13:

1 – Guangdong OPPO Mobile Telecom. We agree with both Proposal 1 and 2, in that, for objectives such as SL-U, beam management and LTE/NR-V co-channel coexistence can benefit from having a study phase at the beginning to update and understand evaluation methodology, reusing the existing CSI framework, and feasibility of different schemes.
2 – DOCOMO Communications Lab. OK with proposal 1 and 2. As general views, we would like to repeat that Rel-18 SL scope should be reasonable, i.e. too wide scope should be avoided.
3 – LG Electronics Inc. We agree with the proposals.
4 – InterDigital We support both proposals.
5 – Huawei Tech.(UK) Co.. Ltd On proposal 1, there are already plenty of Uu designs which can be reused or taken as a baseline to adapt for sidelink, including Uu beam management, NR-U channel access, Rel-16 in-device coexistence framework, etc., and thus the study phases should focus on identification of feasible and necessary modifications based on existing design to support sidelink operation. With this understood, it is worth discussing in December whether we can end the study phase in RAN#97 instead of RAN#98, to leave 2 more RAN WG meetings for normative work. We are fine with the proposal 2.
6 – Apple GmbH For Proposal 1, we think the timeline of finishing the study phase depends on the objective itself. For example, we do not think long study phase is needed at least for the objective of LTE-NR coexistence. We support Proposal 2.
7 – Nokia Denmark The initial study phase should be used to help RAN to decide the detailed scope/objectives of each feature to be specified in Rel.18 based on the outcome of study; and not to decide if a feature should or not proceed to normative work during Rel.18. This

Therefore, we propose the following reformulation of proposal 1:

Proposal 1: For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.

−For the objectives subject to a study phase, RAN to determine in RAN#98 the scope of the specification support in Rel-18

We support proposal 2.

8 – Futurewei

We can accept proposal 1 (though we prefer that unlicensed should be study and specify) and support proposal 2.

9 – Ericsson LM

We are fine with the first proposal, although we think that RAN#99 would be a more appropriate checkpoint given the size of the studies and that RAN2-4 will only start their work in Q3.

We are fine with the second proposal as long as it is clearly understood that secondary working groups will have TU allocation that is significantly smaller than that for RAN1. This is especially important for RAN2, as they are the leading WG for the SL relays work.

Regarding the scope, we still think that the scope is way beyond what the RAN WGs can deal with in one release. We think that further scope reduction is necessary, preferably by removing some of the main objective (rather than pruning the list of topics within each objective).

10 – CATT

We can support the two proposals. Agree with other company maybe RAN#99 is more appropriate time for the end of study phase but OK with #98 if this is the majority view. The conclusion for the objectives for study should be captured in a TR. It is the understanding that further selection will be done for those objectives.

11 – MediaTek Inc.

We support both proposals.

12 – TOYOTA Info Technology Center

We support both proposals.

13 – Samsung Electronics Romania

We support both proposals.

14 – vivo Communication Technology

We are fine with these proposals.

15 – China Mobile E-Commerce Co.

We are supportive of the two proposals.

16 – Qualcomm CDMA Technologies

We support the proposals.

17 – Asia Pacific Telecom co. Ltd

We support the proposals.

18 – TELECOM ITALIA S.p.A.

We DO NOT support to proposal. This is not acceptable.

The amount of work envisaged for this activity is crazy. Rather than removing sub-bullets from the objectives entire objectives must be removed. Proposal: either remove SL-U or SL in FR2 (or even better both). Those are entire projects by themselves and the amount of work required is likely to fill RAN1, 2, 3 and 4 for several releases.

Finally impact on RAN4 must be clarified since the beginning. We cannot accept that RAN4 is overflowed by this activity.

19 – Beijing Xiaomi Mobile Software

We are fine with both proposal 1 and proposal 2.

20 – ZTE Wistron Telecom AB

We support the proposals.

21 – Sony Group Corporation

We are fine with both proposals.

22 – NEC Corporation

We generally agree on proposal 1, but it may be unnecessary to continue the study phase until RAN #98.

To ensure the progress of Rel-18 sidelink discussion, we propose to complete the study phase before RAN #97 and determine the further issues that need to be specified in #97 meeting.

23 – CAICT

support moderator's proposals

24 – Transsion Holdings

We support these two proposals.

25 – Lenovo (Beijing) Ltd

We support a work item for Rel-18 sidelink enhancement. However, in Proposal 1, it is quite unclear which objectives need a study phase first.

26 – Continental Automotive GmbH

We are supportive to Proposal 2.
However, Proposal 1 looks ambiguous both in terms of the scope for the study phase as well as the following normative work. We hope more clarity can be added to Proposal 1.

27 – Intel Korea

Proposal 1 is acceptable assuming manageable scope is agreed for R18 work.
We agree with Proposal 2.

28 – Philips International B.V.

We agree with the proposals but would like to point out here that the moderator has not created a specific form for Sidelink power savings. We do not agree with the conclusion for Sidelink power saving: "It's clear the situation has not changed". There are at least 12 companies in the intermediate round that have shown interest on Sidelink power saving for Rel-18. For some companies, such as Philips, this topic is more important than some other topics currently being proposed for inclusion in the SI. However, the current forms and questions did not ask companies to express prioritization between the proposed topics and sidelink power saving. Therefore, we do not think it is fair closing this topic without further discussion in RP#94-e

29 – Fraunhofer HHI

We think the study phase can be shortened by at least 1 RAN plenary meeting, to leave more time for the normative work in the respective RAN meeting group. We agree with Proposal 2.

4.1.2 Sidelink CA

Proposal 3: *Specify mechanism to support NR sidelink CA operation based on LTE sidelink CA operation [RAN1, RAN2, RAN4]*

- *Prioritize supporting LTE sidelink CA features for NR (i.e. SL carrier (re-)selection, synchronization of aggregated carriers, handling the limited capability, power control for simultaneous SL TX, packet duplication)*
- *Sidelink CA operation is not support in Rel-18 for unlicensed spectrum or for FR2*

Companies are invited to provide their views with respect to the above proposal 3.

Feedback Form 14:

1 – Guangdong OPPO Mobile Telecom.

We are supportive of specifying CA mechanism for NR sidelink based on reusing LTE sidelink CA operation to simplify the specification work, and to prioritize LTE sidelink CA features for NR in R18. And since it is yet unclear how SL-U and FR2 beamforming would operate and their impacts to the CA operation, we suggest the 2nd sub-bullet is updated as "Sidelink CA operation is not supported in R18 for unlicensed spectrum **and** for FR2".

2 – DOCOMO Communications Lab.

We are generally fine with this proposal but ”CA scheduled by gNB” should clearly be mentioned under ”i.e.”, which is included in LTE SL CA. At the same time, it should clearly be mentioned that Rel-16/17 NR-SL-specific features like aperiodic reservation, SL HARQ-ACK report on SL/UL will be covered.

3 – LG Electronics Inc.

We agree with the proposal. We feel that RAN2 can be the leading WG with this formulation.

4 – InterDigital

We agree with the proposal. As we suggested earlier, we prefer to restrict the scope of R18 SL CA to FR1 only and thus it should be clearly indicated by e.g.,

”Sidelink CA operation support in Rel-18 is for FR1 licensed spectrum only”.

5 – Huawei Tech.(UK) Co.. Ltd

We would like to ask proponents for more clarity on exactly what are the intended band combinations for this CA, and what motivates those combinations in terms of use cases and scenarios. With that clearly stated, it becomes possible to properly evaluate the commercial justification for the proposal.

Without spectrum extension from Rel-16/17 to unlicensed and/or FR2 spectrum, to us it seems there is little benefit on SL CA in existing Rel-16/17 spectrum, particular the ITS spectrum, of which bandwidth it is very limited subject different region. And Rel-17 excluded SL CA from WI scope due to similar reason. On this basis, we do not support proposal 3 as it stands.

6 – Apple GmbH

We are fine with the proposal.

7 – Futurewei

We are generally fine with the proposal. However, we think ‘Prioritize’ in the first subbullet might still encourage too much time to be spent on new features, and it is not quite fair to have the study and specification of new features hidden here. We prefer to change ‘Prioritize supporting’ to ‘Support only’.

A typo correction on the second subbullet, support –> supported.

8 – Ericsson LM

We are generally fine with the proposal, but we think that it would be good to list what other CA aspects (beyond those in LTE) will be specified. In our view, this includes:

- Support for SL CA for UC/GC, including SL HARQ-ACK reporting
- Support for Mode 1, including SL HARQ-ACK reporting to the gNB and new DCI format(s).
- Intra-band and inter-band CA are in scope.

We think that it is also important to limit the scope and ensure backwards compatibility:

- Focus on licensed FR1:
  - No specific enhancements for FR2.
  - No FR1+FR2 aggregation
- This feature is backwards compatible in the following regards:

- Rel-16 UEs can receive Rel-18 SL BC/GC transmissions with CA for the carriers on which they receive and transmit the corresponding SL HARQ feedback.
- Assuming this SL functionality would co-exist in the same resource pools as Rel-16/Rel-17 functionalities (e.g., no changes to reservations in SCI, etc.)

Note that these last two bullets are very similar to what was used for LTE.

9 – MediaTek Inc.

We have a similar concern to Huawei's, expressed above. Excluding unlicensed spectrum and FR2 limits the applicability of SL CA. There was some divergence in the spectrum in which companies expressed interest in the intermediate round, and it's not clear to us that the views support this limitation.

10 – TOYOTA Info Technology Center

We support the proposal.

11 – Samsung Electronics Romania

We are supportive of the proposal.

12 – vivo Communication Technology

We don't support the second sub-bullet. If SL CA is only applicable to FR1 licensed band, the benefits of this feature become very limited, especially for FR2 operation. The intention of this sub-bullet seems to reduce the work load. However, we have to point out that it may instead lead to the opposite way. For example, due to limited number of antennas can be deployed in the UEs for SL communication, very complicated solution would be needed to support standalone operation in FR2 (or other spectrum) to resolve the coverage issue between UEs without assistance from FR1 band, which would actually increase the overall work load of the WI.

13 – CATT

We think SL CA should not exclude exclude F2 operation. To limit the scope we can have no specific enhancements for FR2, but FR1+FR2 aggregation is essential.

14 – China Mobile E-Commerce Co.

We share similar views as DCM and InterDigital that since "Prioritize" is used in the objective, it would be better to clarify whether new features introduced by NR-V should be covered.

15 – Qualcomm CDMA Technologies

For specifying NR sidelink CA, we agree with the principle of leveraging LTE sidelink CA work as much as possible. However, we believe this is adequately captured in the 1st sub-bullet of the proposal, that mentions the features to prioritize. The clause '*based on LTE sidelink CA operation* ' in the main proposal appears unnecessary and also unclear as to what further restrictions it implies beyond those in the 1st sub-bullet. Hence we propose to delete that clause

As we noted in our previous responses and by other companies, we would prefer to prioritize unlicensed spectrum (FR1 and FR2) and FR2 licensed spectrum over sidelink CA. However, if sidelink CA is being specified, there are likely to be many aspects of sidelink CA that can easily apply not only to FR1 licensed but also to FR2 and unlicensed spectrum (both FR1 and FR2) with minimum further effort. Hence, not

supporting it at all in these bands would be unnecessarily restrictive. We would prefer to delete the second sub-bullet.

16 – Asia Pacific Telecom co. Ltd

We support the proposal.

17 – Beijing Xiaomi Mobile Software

We can accept the proposal although we support to consider unlicensed spectrum in sidelink CA. In addition, we think it is necessary to support CA for NR specific sidelink features such as HARQ-ACK.

18 – Sony Group Corporation

We are generally fine to prioritize supporting LTE sidelink CA features for NR. In addition, we prefer to support NR sidelink feature like HARQ-ACK reporting for the NR sidelink CA.

We also fine with focusing on FR1 licensed band for Rel-18 sidelink CA. But we can consider a forward compatibility for FR1 unlicensed band and FR2 licensed band.

19 – ZTE Wistron Telecom AB

We support the proposal. With the two sub-bullets, the scope seems reasonable.

20 – Nokia Denmark

We support proposal 3.

21 – NEC Corporation

We agree on proposal 3.

22 – Volkswagen AG

Proposal 3 is supported.

23 – CAICT

We are fine with proposal 3.

24 – Transsion Holdings

We are generally fine with this propsoal. We share the similar views as Ericsson that other aspects beyond LTE SL CA, such as SL HARQ mechanism should be listed in the proposal.

25 – Lenovo (Beijing) Ltd

We are generally OK with the main bullet and prefer taking LTE sidelink CA as baseline.

Regarding the two sub-bullets, we think it unnecessarily excludes the features of cross-carrier scheduling, HARQ-ACK feedback enhancement and CA for unlicensed spectrum, which makes Rel-18 sidelink CA too compact.

26 – Intel Korea

We support proposal 3. There is small typo in the last sentence – “is not support**ed**”

27 – Philips International B.V. We agree with the proposals but would like to point out here that the moderator has not created a specific form for Sidelink power savings. We do not agree with the conclusion for Sidelink power saving: "It's clear the situation has not changed". There are at least 12 companies in the intermediate round that have shown interest on Sidelink power saving for Rel-18. For some companies, such as Philips, this topic is more important than some other topics currently being proposed for inclusion in the SI. However, the current forms and questions did not ask companies to express prioritization between the proposed topics and sidelink power saving. Therefore, we do not think it is fair closing this topic without further discussion in RP#94-e
28 – Continental Automotive GmbH In our view, for CA in sidelink should consider unlicensed spectrum for both FR1 and FR2, and licensed spectrum for FR2. We support the proposal as long as 2nd bullet is removed.
29 – Philips International B.V. **Please ignore previous comment, submitted in wrong form** We agree with the proposal
30 – Fraunhofer HHI We are fine with the first bullet. We do not see the need to restrict SL CA as indicated in the second bullet. At least the FR1 + FR2 aggregation should be included.

4.1.3 FR1 unlicensed spectrum operation

Proposal 4: *Study the support of sidelink on FR1 unlicensed spectrum for both mode 1 and mode 2 where Uu operation for mode 1 is limited to licensed spectrum only [RAN1, RAN2, RAN4]*

- *Evaluation methodology for sidelink operation on unlicensed spectrum*
- *Sidelink channel access mechanism for unlicensed spectrum*
- *Required changes to NR sidelink physical channel structures and procedures to operate on unlicensed spectrum*
    - *No specific optimizations for Rel-17 SL features (e.g., DRX, resource allocation for power saving, inter-UE coordination, etc.)*

RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.

Companies are invited to provide their views with respect to the above proposal 4.

Feedback Form 15:

1 – Guangdong OPPO Mobile Telecom.

We are OK with the updated Proposal 4 to further restrict the scope for SL-U, where only the licensed spectrum is considered for the Uu link in Mode 1.

Regarding the 2nd sub-bullet on channel access mechanism for unlicensed spectrum, it should be further clarified that the study should be based on regional regulation requirement and use the existing channel access schemes from NR-U as a starting point.

- "*Sidelink channel access mechanism for unlicensed spectrum* ***based on regional regulation requirement and use the existing channel success schemes from NR-U as a starting point.***"

Additionally, the unlicensed spectrum bands of interest should be 5G and 6GHz.

- "***Frequency bands for the unlicensed spectrum in FR1 are 5GHz and 6GHz.***"

2 – DOCOMO Communications Lab.

Now scope is limited well, so we can accept this proposal.

3 – LG Electronics Inc.

If FR1 unlicensed spectrum operation needs to be included in Rel-18, we think this proposal can be a reasonable framework. We would like to add a few more points:

- When the objective says mode 1 and mode 2, we assume they refers to Rel-16 resource allocation mechanism. We understand the channel access mechanism for unlicensed spectrum would not be a completely new resource allocation but some modification to the existing operations. So a sub-bullet like "This should reuse Rel-16 resource allocation mechanism as much as possible" needs to be added to clarify this intention.

- The changes to procedures seem to imply that any Rel-16 features can be considered for update, but we think this would expand the study scope unnecessarily and be undesirable given the short study phase. We think most of Rel-16 features can be reused without changes for the unlicensed spectrum operation as mentioned in the previous round, but if it is not easy to figure out a concrete list of potentially updated features, we propose to add the same note to non-essential changes to Rel-16 SL features: No specific optimizations for Rel-17 SL features (e.g., DRX, resource allocation for power saving, inter-UE coordination, etc.) and unlicensed spectrum operable Rel-16 SL features.

4 – InterDigital

We think the described SL U scope is reasonable and we support the proposal.

5 – Huawei Tech.(UK) Co.. Ltd

Similar with CA, it will be valuable if the proponents of FR1-only work can set out the spectrum and bandwidth they think is added by this whilst limited to FR1 only, and which use cases it enables, that are not possible with the existing support of FR1. There needs to be a clear benefit over the existing licensed sidelink support in FR1, if FR2 is not included.

In general, we think it is not desirable to to limit the scope to FR1 unlicensed spectrum only, because the wider bandwidth available in FR2 (even in FR2-2 only) enables many more use cases than in FR1.

6 – Apple GmbH

We are fine with the proposal. We think it is a reasonable scope.

7 – Nokia Denmark

We support proposal 4.

However the goal of the study phase should be to clarify the scope of the Rel.18 SL-U specification support and not to decide if SL-U should or not be specified during Rel.18. So we propose the following text change:

RAN to determine in RAN#98 the scope of the specification support in Rel-18

8 – Futurewei

As in our general response, we feel that this one it is better to make it a study and specify given the support level for the objective.

Since there would be a study period to determine the essential features of the SL-U, it is better not to limit the scope too much for now. We suggest that the wording in the main bullet "where Uu operation for mode 1 is limited to licensed spectrum only" is better to be made as a subbullet as shown below.

Proposal 4: *Study the support of sidelink on FR1 unlicensed spectrum for both mode 1 and mode 2 ~~where Uu operation for mode 1 is limited to licensed spectrum only~~ [RAN1, RAN2, RAN4]*

- *Evaluation methodology for sidelink operation on unlicensed spectrum*
- *Sidelink channel access mechanism for unlicensed spectrum*
- *For non-standalone case, Uu operation for mode 1 is limited to licensed spectrum only*
- *Required changes to NR sidelink physical channel structures and procedures to operate on unlicensed spectrum*

o *No specific optimizations for Rel-17 SL features (e.g., DRX, resource allocation for power saving, inter-UE coordination, etc.)*

RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.

9 – Ericsson LM

We are generally fine with the proposal, but we think it would be good to clarify that:

- The LBT categories in NR-U should be reused unless they are not suitable at all. Discussions on new LBT categories will likely delay progress a lot.
- There shall be no specific optimizations for Rel-17 SL features as well as Rel-18 SL features.
- No wideband operation in Rel-17 (i.e., single LBT BW).

10 – MediaTek Inc.

We are OK with most aspects of the proposal, with two concerns:

- Not having FR2 excludes a lot of useful spectrum that can support demanding use cases, so we still think it would be preferable to include FR2.
- We understand that the study phase is intended to clarify the scope and impact, not to determine whether or not to support the feature; so we agree with Nokia about the rewording of the final sentence.

11 – TOYOTA Info Technology Center

We support the proposal.

12 – Samsung Electronics Romania

We are supportive of the proposal.

13 – vivo Communication Technology

Firstly, we don't agree the sub-bullet of "*No specific optimizations for Rel-17 SL features…*". Given that no power saving mechanism is specified in Rel-16, this sub-bullet means no power saving mechanism for SL over unlicensed. This is not acceptable for us. For commercial usages, which is one of the most important usages of SL over unlicensed, power saving is an essential feature for SL devices. Without power saving mechanism, the NR SL has no competitive advantage at all compared with other technologies in unlicensed band! We can only accept if the whole sub-bullet is **removed**, or revised as:

- *No specific optimizations for ~~Rel-17 SL features (e.g., DRX, resource allocation for power saving,~~ inter-UE coordination~~, etc.)~~*

Secondly, we share a similar view with Huawei and MediaTek that the work is not necessary to be limited in FR1. We can focus the study on FR1, but do not have to limit the outcome only for FR1, i.e., the FR2 can be supported without special optimization (similar to the support of FR2 in Rel-16 NR SL). Thus, we can r**emove the "*FR1*" from the main bullet**, and add the following sub-bullet instead:

- *No specific optimizations for FR2*

14 – CATT

We are in principle fine with the wording. But for the sub-bullet we have a concern.

'*No specific optimizations for Rel-17 SL features (e.g., DRX, resource allocation for power saving, inter-UE coordination, etc.)*'

We think this should not be limited to Rel-17 SL features, actually, we prefer the following:

No specific optimizations for existing NR SL features

15 – China Mobile E-Commerce Co.

We are fine with the proposal.

16 – Qualcomm CDMA Technologies

We propose to include both FR1 and FR2 unlicensed spectrum. It has been brought up by multiple companies and, in our opinion, deserves further consideration.

Indeed, FR2-2 opens up quite many opportunities to fully realize the sidelink capabilities desirable for some very high data rate applications that would be unfortunate to dismiss.

17 – Asia Pacific Telecom co. Ltd

We support this proposal.

18 – TELECOM ITALIA S.p.A.

As stated in the general comment, the whole proposal is too large. Stating that we do not support SL-U, reasonable objectives should be defined for the whole activity. Either SL-U or SL in FR2 (or even better none) should be studied in Rel 18, not both. And we do not think a normative phase can be completed in Rel 18, considering the impact on RAN2 and RAN4.

19 – Beijing Xiaomi Mobile Software

We think the study scope is well limited and support the moderator's proposal.

20 – Sony Group Corporation

We are fine with the proposal.

21 – ZTE Wistron Telecom AB

We support the proposal, and the scope is reasonable now.

22 – NEC Corporation

We agree on the study scope of SL-U in proposal 4.

Besides, as mentioned in general views, we propose to complete the study phase of SL-U before RAN #97 considering 6-months study phase should be sufficient.

23 – CAICT

We support proposal 4.

24 – Lenovo (Beijing) Ltd

We are generally OK with this proposal.

25 – Transsion Holdings

We are fine with the proposal.

26 – Intel Korea

Thanks a lot for revision. We would like to get clarification on whether presence of incumbent technologies is considered and whether it is supposed to be discussed as a part of evaluation methodology. If so, it is necessary to clarify which technologies need to be considered. Given that Uu operation for Mode-1 is limited to licensed spectrum only, does it mean that scenario when both NR-Uu unlicensed and NR PC5 unlicensed operate on the same carrier is out of scope? It is also important to clarify primary use case(s) considered for sidelink unlicensed evaluation and design work. For example, we would like to check if unlicensed sidelink for I-IOT URLLC scenarios is in scope and whether <1ms latency should be targeted. As a group, we need to be clear on KPIs and in which scenarios we try to achieve those.

27 – Philips International B.V.

We agree with Vivo

28 – Continental Automotive GmbH

In our view, support for FR2 should be studied in Rel 18. We support unlicensed FR1, but a lot of existing work of NR can be reused for addressing the support of FR2 unlicensed. We do not understand the need to limit the work towards unlicensed spectrum to FR1.

29 – Fraunhofer HHI

We are supportive of the objectives listed, the wording could be rephrased to "study and specify" since we believe the normative work should begin after the study phase. We believe that the study phase could be shortened, see our comment for Proposal 1.

4.1.4 Enhanced FR2 licensed spectrum operation

Proposal 5: *Specify enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]*

- *Work is limited to the support of sidelink beam management by enhancing existing sidelink CSI framework*

Companies are invited to provide their views with respect to the above proposal 5.

Feedback Form 16:

1 – Guangdong OPPO Mobile Telecom.

On support of beam management for NR sidelink, we wonder if the work required / involved is sufficiently clear to everyone. It is currently not clear to us how to specify SL beam management by enhancing the existing sidelink CSI framework. In Rel-16, we have not touched on beam management at all. The PT-RS in FR2 is only for phase tracking regardless of beamforming. The CSI framework was done considering only MIMO CQI and RI reporting. It is unclear to us how this CSI framework is / can be extended to support beam management. We wonder if this topic also deserves some study at the beginning of R18 to understand the feasibility and how to reuse the existing CSI framework to support beam management. Similar to SL-U, we believe a study phase can greatly benefit the specification/normative work later on.

2 – DOCOMO Communications Lab.

We still have concern on supporting both SL-U and SL-FR2 from scope-size perspective and motivation perspective. The motivation would be covered by SL-U support. Either should be fine. Now it seems SL-U has more supports, then SL-FR2 can be dropped.

If included in Rel-18, we have similar view with OPPO, study phase is needed since beam management has not been studied sufficiently yet. We do not support to start as work item.

3 – LG Electronics Inc.

We agree with this proposal.

4 – InterDigital

We agree with the proposal regarding the restriction to SL beam management based on enhancements on the existing CSI framework. However, we think synchronization in FR2 (e.g., beamformed SSB) should

another essential topic to cover.

5 – Huawei Tech.(UK) Co.. Ltd

We agree that beam management and CSI would need to be added for full support of FR2.

6 – Apple GmbH

We are fine with the proposal. Sidelink beam management with CSI framework enhancement is necessary for sidelink FR2 operations.

7 – Nokia Denmark

We support proposal 5.

8 – Futurewei

We are supportive of this proposal.

9 – Ericsson LM

We still have concerns with the size of the WI. In this regard, we are supportive of the clarification on the limited scope.

In addition, we think it is necessary to bring back the statement on "lower priority" that was part of the earlier version and give it a proper meaning. From our point of view, any of the following two options would be acceptable:

- This objective has low priority and will only be specified upon completion of the other objectives.
- This objective will only be discussed after RAN#99. In this latter case, it would be appropriate to study it until RAN#99, like unlicensed SL or co-channel coexistence.

10 – Verizon UK Ltd

The detailed analysis regarding the reasonable workload of the reduced scope on this topic has been provided by companies during the intermediate round. We agree with the companies' analysis and agree with the current proposal. With this very limited work scope, we don't think there is a need to define a "lower priority" concept specific to this topic.

11 – MediaTek Inc.

We support this proposal. In particular, we think the limitation to beam management through CSI framework enhancement keeps the work scope from being unreasonable.

12 – TOYOTA Info Technology Center

We support the proposal.

13 – Samsung Electronics Romania

We are supportive of the proposal.

14 – vivo Communication Technology

We are fine with the proposal.

15 – Panasonic Corporation

We support the proposal.

16 – CATT

we support the proposal

17 – China Mobile E-Commerce Co.

We are fine with the proposal.

18 – Qualcomm CDMA Technologies

For efficient FR2 sidelink operation, sidelink beam management should include initial beam-pairing, beam maintenance, and beam failure recovery. Enhancing the existing sidelink CSI framework is a good step to supporting these operations, but is not sufficient in itself. We propose to reword the sub-bullet as follows:

Work is limited to the support of sidelink beam management (including initial beam-pairing, beam maintenance, and beam failure recovery) by enhancing existing sidelink CSI framework and reusing Uu beam management concepts wherever possible.

19 – Asia Pacific Telecom co. Ltd

We are fine with this proposal.

20 – TELECOM ITALIA S.p.A.

As stated in the general comment, the whole proposal is too large. Stating that we do not support SL in FR2, reasonable objectives should be defined for the whole activity. Either SL-U or SL in FR2 (or even better none) should be studied in Rel 18, not both. And we do not think a normative phase can be completed in Rel 18, considering the impact on RAN4.

21 – Beijing Xiaomi Mobile Software

In our view we would prefer to drop this objective for Rel-18 sidelink. if this objective is included in the work scope, we have similar opinion as other companies that a study phase is necessary.

22 – Sony Group Corporation

We are fine with the proposal.

23 – ZTE Wistron Telecom AB

We have a bit concern on the whole scope and the detailed specification work as raised by some companies above. In our point of view, a study phase is helpful to let the whole WI work go smoothly.

24 – CAICT

We are fine with the scope provided in proposal 5. However, we think the priority of this part is lower than Sidelink-U and CA.

25 – Lenovo (Beijing) Ltd We prefer low priority for FR2 licensed compared to sidelink CA and FR1 unlicensed.
26 – Transsion Holdings We are fine the proposal.
27 – Intel Korea We are supportive of the objective. To facilitate progress, we would like to add more clarification on target functionality and use cases to avoid unnecessary debates at working group level. Beam management is a broad term that implies a lot of functionalities from radio-layer perspective and thus further details are necessary to have clear scope. 1) One of the questions is whether there is an intention that functionality is limited to unicast sidelink communication only as sidelink CSI framework is supported only for unicast links? Our understanding the objective is limited to optimize unicast sidelink transmissions and does not target other cast types. 2) Another question that would be good to clarify is whether we consider sidelink communication in licensed FR2, w/o sidelink support in FR1 licensed spectrum (i.e., standalone sidelink on FR2 licensed spectrum). Our understanding is that scenario is limited to FR2 only sidelink. Needs to be clarified. 3) Additional question is whether out of coverage scenarios are of interest or the work is limited to in-coverage and/or partial coverage? Our understanding is that the primary scenario is in-coverage. We think that for efficient work and progress in R18 additional discussion/clarification is desirable. If there is no convergence at RAN level, the study phase seems helpful to determine and meet this objective
28 – Continental Automotive GmbH We support this proposal.
29 – Verizon UK Ltd One of the important use cases we see from our side is Uu FR2/sidelink FR2 for FR2 coverage extension
30 – Fraunhofer HHI We agree with the proposal, however, we would place SL-U in higher priority than FR2.

4.1.5 Sidelink power saving

No further discussion on sidelink power saving in final round

4.1.6 LTE-NR coexistence

Proposal 6: *Study mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance, necessity, feasibility, and potential specification impact [RAN1, RAN2, RAN4]*

- *Reuse the in-device coexistence framework defined in Rel-16 as much as possible*

RAN to determine in RAN#98 whether there is to be specification support in Rel-18 or not.

Companies are invited to provide their views with respect to the above proposal 6.

Feedback Form 17:

1 – Guangdong OPPO Mobile Telecom. We are fine with Proposal 6. It would be good in the study scope to cover the following two alternatives from our August discussion: Alt. 1: Resource pool separation between the two RATs Alt. 2: Dynamic resource sharing using overlapping resource pools between the two RATs
2 – DOCOMO Communications Lab. We support this proposal while necessity of the sub-bullet is unclear for us.
3 – LG Electronics Inc. We agree with this proposal.
4 – InterDigital We support this proposal.
5 – Huawei Tech.(UK) Co.. Ltd It should say "...potential specification impact**, if any**", but otherwise we are ok with the proposal. The sub-bullet is important in managing the scope without starting unnecessarily from a blank sheet.
6 – Apple GmbH For this objective, we do not think long study phase is needed. RAN can determine whether there is to be specification support in Rel-18 in an earlier RAN plenary meeting. We think the sub-bullet is not needed, as we mentioned in the intermediate round.
7 – Nokia Denmark We support proposal 6.
8 – Futurewei Although we think this proposal should be lower priority and prefer not to include it in Rel-18 WI, we are ok with a performance study for the LTE-NR co-channel coexistence based on existing spec.
9 – Ericsson LM We are supportive of this proposal.
10 – MediaTek Inc. It should be clear that the study phase may conclude without identifying spec impact. We don't see this as a high-priority item, but we can accept a study of *whether* to specify something (as opposed to *what* to specify).

11 – TOYOTA Info Technology Center We support the proposal.
12 – Samsung Electronics Romania We are supportive of the proposal.
13 – Panasonic Corporation We support the proposal.
14 – vivo Communication Technology If work load is a concern, as commented on other objectives by companies, we think this objective should be given low priority.
15 – CATT We are supportive of this proposal.
16 – China Mobile E-Commerce Co. We are fine with the proposal.
17 – Qualcomm CDMA Technologies We support the proposal.
18 – Asia Pacific Telecom co. Ltd We support this proposal.
19 – Beijing Xiaomi Mobile Software We are fine with the proposal.
20 – Sony Group Corporation We are fine with the proposal.
21 – ZTE Wistron Telecom AB We support this proposal.
22 – VODAFONE Group Plc We support this work.
23 – NEC Corporation We agree on this proposal.

24 – CAICT Support
25 – Lenovo (Beijing) Ltd We are OK with this proposal.
26 – Transsion Holdings We are fine with this proposal.
27 – Volkswagen AG As mentioned there is a need to have an efficient coexistence framework for LTE-V2X and NR-V2X within a Rel-18 timeframe. Proposal 6 is too vague if and when such framework might get specified. Also previous discussion have shown that many companies see a benefit for a dynamic resource allocation. Therefore an alternative wording is proposed, e.g.: ***Proposal 6:*** *Study mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance, necessity, feasibility, and potential specification impacts [RAN1, RAN2, RAN4] until RAN#98.* *The study should consider a dynamic scenario with overlapping resource pools between the two RATs.* *The in-device coexistence framework defined in Rel-16 may be reused as much as possible* *If specification impacts were identified, start a normative work after RAN#98.*
28 – Intel Korea We agree with proposal 6
29 – Fraunhofer HHI We support the proposal.

4.1.7 Justification on Rel-18 NR sidelink

In Rel-16, sidelink communication was developed in RAN mainly to support advanced V2X applications. In Rel-17, SA2 studied and standardized Proximity based service including commercial related service. As part of Rel-17, power saving solutions (e.g partial sensing, DRX) and inter-UE coordination have been developed in RAN1 and RAN2 to improve power consumption for battery limited terminals and reliability of sidelink transmissions.

Although NR sidelink was initially developed for V2X applications, there is growing interest in the industry to expand the applicability of NR sidelink to commercial use cases. One use case is where NR sidelink is used as a wireless interface between a head mounted display such as XR glasses and a smartphone. In accordance to this trend, SA1 studied use cases for NCIS (network controlled interactive services) and specified related requirement in Rel-16. In TR22.842, local users of IoE based social network can be provided with real time virtual scene by proximity smart terminals. In TR 26.928 more use cases involving sidelink communication are studied such as online XR gaming, media sharing etc. when users are close together. In requirement of NCIS is captured in table 7.6.1-1 in TS 22.261 where the data rate is 0.1 [1] Gbps for gaming or interactive data

exchanging.

For advanced V2X and commercial sidelink applications, two key requirements have been identified:

- *Increased sidelink data rate*
- *Support of new carrier frequencies for sidelink*

Increased sidelink data rate is motivated by applications such as sensor information (video) sharing between vehicles with high degree of driving automation where the peak data rate could be 1000 Mbps (700 Mbps) within a range of 50 m(200 m). Commercial use cases such as XR gaming could require data rates in excess of what is possible in Rel-17. While the support of new carrier frequencies would also allow to improve its data rate, the main benefit would come from making sidelink more applicable for a wider range of applications. More specifically, with the support of unlicensed spectrum, sidelink will be in a better position to be implemented in commercial devices since sidelink can be realized without having to rely on ITS band.

Another aspect to consider is the deployment scenario where both LTE V2X and NR V2X devices are to coexist in the same frequency channel. For the two different type of devices to coexist while using a common carrier frequency, it is important that there is provisioning to maximize resource utilization between the two technologies. This requirement was also mentioned as part of the input from 5G Automotive Association to the Rel-18 RAN Workshop.

Companies are invited to provide their views on the above justification for Rel-18 NR sidelink.

Feedback Form 18:

1 – Guangdong OPPO Mobile Telecom. We are fine with the proposed justification text.
2 – LG Electronics Inc. We think the text can be a good starting point. We would like leave a few comments for possible updates: - As the proposals include three options (CA, unlicensed spectrum, FR2) that can serve the purpose of the increased sidelink data rate, it would be good to mention all of them in that context. - On “More specifically, with the support of unlicensed spectrum, sidelink will be in a better position to be implemented in commercial devices since sidelink can be realized without having to rely on ITS band,” we understand that no clear needs have been found for V2X in using unlicensed spectrum thus we propose not to mention ITS band in this sentence. - We propose to update the last paragraph to include sidelink CA in order to note that this was a part of 5GAA input. For the ITS purpose, sidelink CA can provide a means to use multiple channels fragmented in an ITS band.
3 – Apple GmbH We support the above justification for Rel-18 NR sidelink in general. Maybe, we do not need to mention any particular use case in the justification.

4 – Nokia Denmark

The justification uses SL-U as the main example on how to obtain increased sidelink data rate (even in the context of V2X), but then the SL-U proposal (proposal 4) is to condition the execution of the specification support during Rel.18 based on the outcome of the study item phase. Additionally, there is no justification provided for CA and FR2 in the current text.

5 – Futurewei

The justification is generally fine. Since SL FR2 enhancement is one of the proposals to be included in Rel-18, we suggest to have it explicitly mentioned in the justification. We propose the following updates on the second to last paragraph.

While the support of new carrier frequencies and larger bandwidths would also allow to improve its data rate, the main benefit would come from making sidelink more applicable for a wider range of applications. More specifically, with the support of unlicensed spectrum and the enhancement in FR2, sidelink will be in a better position to be implemented in commercial devices since sidelink can be realized without having to rely on ITS band.

For the co-channel coexistence, it is too ambitious with the objective of maximizing resource utilization between LTE and NR V2x. We suggest the following change on the last paragraph.

Another aspect to consider is the deployment scenario where both LTE V2X and NR V2X devices are to co-exist in the same frequency channel. For the two different types of devices to coexist while using a common carrier frequency, it is important that there is provisioning to ~~maximize~~ improve resource utilization between the two technologies. This requirement was also mentioned as part of the input from 5G Automotive Association to the Rel-18 RAN Workshop.

6 – Ericsson LM

We think that it is better to avoid including specific KPIs and instead prefer referring to the corresponding TSs, as these include a context and description:

- Remove "*where the data rate is 0.1 [1] Gbps for gaming or interactive data exchanging*"
- Remove "*automation where the peak data rate could be 1000 Mbps (700 Mbps) within a range of 50 m(200 m)"*

In the first paragraph, public safety should be mentioned too:

- *In Rel-17, SA2 studied and standardized Proximity based service including public safety and commercial related services.*

We think that the second paragraph, which includes a very specific and narrow example, should be removed. It is better to just say that:

- *Although NR sidelink was initially developed for V2X applications, there is growing interest in the industry to expand the applicability of NR sidelink to other use cases.*
- *Add references to their SA1 TSs (public safety, v2x, NCIS)*

In the third paragraph:

- Remove "*such as XR gaming*"

- Remove "*since sidelink can be realized without having to rely on ITS band". This band is no applicable for other UCs than V2X.*

7 – MediaTek Inc.

We generally find this justification OK, but the text should reflect the objectives that are ultimately captured (e.g. CA, FR2).

With respect to Ericsson's comment about including specific KPIs, if there is a general feeling to make such a change, we still think it's important to indicate where the performance limitations of Rel-17 sidelink are. If we want to remove the explicit numbers (e.g. "0.1 [1] Gbps"), we should maintain something about "higher data rates than Rel-17 sidelink can offer" or similar phrasing, with a pointer to the requirement– similar to what's now written for the example of XR gaming.

8 – Samsung Electronics Romania

We are fine with the justification.

9 – CATT

We have a concern for the following sentence:

More specifically, with the support of unlicensed spectrum, sidelink will be in a better position to be implemented in commercial devices since sidelink can be realized without having to rely on ITS band.

we prefer to use the following to better reflect the objectives targeted:

More specifically, with the support of Carrier aggregation, possible operation on unlicensed spectrum and FR2 enhancement, sidelink will be in a better position to be implemented in commercial devices.

10 – Asia Pacific Telecom co. Ltd

we are fine with the wordings. thanks

11 – Beijing Xiaomi Mobile Software

We are supportive to the justification.

12 – ZTE Wistron Telecom AB

We are fine with the proposed justification text in general. A bit of clarification is that, from the point of view of all the objectives in the scope, sidelink CA and sidelink on FR2 should also be mentioned here.

13 – NEC Corporation

We are fine with the justification.

14 – Intel Korea

We have the following comments. Use cases seems divided on commercial (e.g., XR, gaming, NCIS) and V2X without clear mapping to objectives. At least some mapping in justification section between use cases and objectives is needed and should be clarified for intended evaluation and design work, e.g., sidelink CA for FR1 is primarily considered for V2X, licensed FR2 is primarily considered for XR or NCIS, unlicensed FR1 targets are FFS?. From our side, there is certainly no intention of limiting the applicability of a technology to a certain use case. However, we are concerned that design of various features for all

considered use cases is likely to be particularly challenging (there is a need to define some clear bounds). Otherwise, study (or a study phase) seems needed to facilitate convergence.

15 – Philips International B.V.

We agree with Ericsson that the second paragraph way too specific. As mentioned by Ericsson it is better to just say that:

- *Although NR sidelink was initially developed for V2X applications, there is growing interest in the industry to expand the applicability of NR sidelink to other use cases.*
- *Add references to their SA1 TSs (public safety, v2x, NCIS)*

In addition, we would like to add reference to SA1 TR 22.859 about Personal IoT, which has requirements about using sidelink in unlicensed band for establishing so-called PIN direct connections. Perhaps also a reference to SA1 TR 22.855, which as per the table in RP-211644 also has a relation to sidelink. These are further examples of additional NR sidelink use cases.

16 – Continental Automotive GmbH

As some companies also see clear benefits of including FR2 support (both for licensed and unlicensed), We consider convenient that when justifying the scope towards CA and high data rates, the support for operation in FR2 must be mentioned in the justification.

17 – Huawei Tech.(UK) Co.. Ltd

Mostly ok, but in the part about in-device coexistence:

(1) ”maximizing resource utilization between the two technologies” sounds like a specific technical objective, which would need more precise formulation. It is better to leave this part out and let the study determine what is feasible.

(2) We don’t usually name a specific MRP in the justification section. This final sentence needs to be removed. (We note the recent PCG clarifications around this point).

18 – Volkswagen AG

In the recent discussion the support of new sidelink carrier was not mentioned as a key requirement for advanced V2X applications. Further it should be avoid to create the impression that the ITS band could be used for applications out of the ITS-context. In addition the coexistence aspect of LTE-V2X and NR-V2X operating in parallel on the same carrier with negatively impacting each other should be highlighted. Therefore a rewording is suggested:

For ~~advanced V2X and~~ commercial sidelink applications, two key requirements have been identified:

Increased sidelink data rate

Support of new carrier frequencies for sidelink

Increased sidelink data rate is motivated by applications such as sensor information (video) sharing between vehicles with high degree of driving automation where the peak data rate could be 1000 Mbps (700 Mbps) within a range of 50 m(200 m). Commercial use cases such as XR gaming could require data rates in excess of what is possible in Rel-17. While the support of new carrier frequencies would also allow to improve its data rate, the main benefit would come from making sidelink more applicable for a wider range of applications. More specifically, with the support of unlicensed spectrum, sidelink will be in a better

*position to be implemented in commercial devices since ~~sidelink can be realized without having to rely on~~ **the utilization of the** ITS band **is limited to ITS safety related applications**.*

*Another aspect to consider is the **V2X** deployment scenario where both LTE V2X and NR V2X devices are to coexist in the same frequency channel. For the two different type of devices to coexist while using a common carrier frequency, it is important that there is **a mechanism** ~~provisioning~~ to **efficiently utilize** ~~maximize~~ resource **allocations** ~~utilization~~ **by** ~~between~~ the two technologies **without negatively impacting the operation of each technology**. This requirement was also mentioned as part of the input from 5G Automotive Association to the Rel-18 RAN Workshop.*

19 – Fraunhofer HHI

We are fine with the justification as a starting point.

5 Conclusion

5.1 General observations and recommendations from moderator

Based on the company comments over the three rounds of discussions, moderator view is that companies are generally positive to having a work item on Rel-18 sidelink enhancement as long as the work scope is compact. However, it should be noted that at least two companies (Telecom Italia and Deutsche Telekom) have explicitly indicated that the market need is unclear. In addition, Telecom Italia has explicitly indicated that the work scope as described in the final round is too large. They prefer removing either sidelink unlicensed, FR2 sidelink, or both.

Discussion on sidelink power saving was stopped after the intermediate round because the company views on whether it is necessary was not converging. It should be noted that Philips has indicated that sidelink power savings should have been further discussed since it is the most important candidate feature from their perspective.

Moderator's estimate for Rel-18 sidelink enhancement assuming the all proposals from the moderator are endorsed is 2.5 3 TUs in RAN1.

Final round proposals have been revised to address some of the comments in the final round.

For Proposal 1, Nokia commented that "The initial study phase should be used to help RAN to decide the detailed scope/objectives of each feature to be specified in Rel.18 based on the outcome of study; and not to decide if a feature should or not proceed to normative work during Rel.18." However, based on the company views, the current formulation seems more reasonable from moderator point of view. For the issue of which RAN meeting the decision is to be made, there is some difference of opinions among the companies. Making decision in RAN#98 seems like a good compromise.

Proposal 1: *For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.*

- *For the objectives subject to a study phase, RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of this work.*

Proposal 2 is non-controversial. Moderator view is to endorse the proposal.

Proposal 2 (non-controversial): *For sidelink enhancement, RAN1 is the primary working group. Secondary working groups are RAN2 and RAN4.*

For Proposal 3, companies have different views on whether sidelink CA should be supported for FR2 and/or unlicensed spectrum. While the benefit of this feature could be potentially improved with the support of FR2 and/or unlicensed spectrum, majority of companies prioritize FR1 licensed band and the need to have a compact work scope. Furthermore, both FR2 sidelink and sidelink over unlicensed spectrum are subject to a study. Based on these reasons, moderator recommendation is to discuss and determine whether to include FR2 sidelink and/or sidelink over unlicensed for sidelink CA after the relevant study is done (in RAN#98).

Other than the issue of FR2 sidelink and sidelink over unlicensed spectrum, one revision has been made to incorporate the backward compatibility comment from Ericsson.

Proposal 3: *Specify mechanism to support NR sidelink CA operation based on LTE sidelink CA operation [RAN2, RAN1, RAN4]*

- *Prioritize supporting LTE sidelink CA features for NR (i.e. SL carrier (re-)selection, synchronization of aggregated carriers, handling the limited capability, power control for simultaneous sidelink TX, packet duplication)*
- *At least for FR1 licensed spectrum and ITS band*
    - *Whether or not to support sidelink CA for FR2 and/or unlicensed band is to be decided in RAN#98 after the relevant studies are done*
- *This feature is backwards compatible in the following regards*
    - *Rel-16 UEs can receive Rel-18 sidelink broadcast/groupcast transmissions with CA for the carriers on which they receive and transmit the corresponding sidelink HARQ feedback.*
    - *Assuming this sidelink functionality would co-exist in the same resource pools as Rel-16/Rel-17 functionalities (e.g., no changes to reservations in SCI, etc.)*

For Proposal 4, the proposal has been revised to accommodate company views which are supportive of FR2 unlicensed band. The support of FR2 unlicensed band is included with the limitation that there will not be any FR2 unlicensed band specific optimization. This would be similar to how FR2 sidelink was supported in Rel-16. From moderator view, considering the serious concerns on the size of the sidelink enhancement work scope on Rel-18, this seems to be a reasonable way forward.

Proposal 4: *Study the support of sidelink on unlicensed spectrum for both mode 1 and mode 2 where Uu operation for mode 1 is limited to licensed spectrum only [RAN1, RAN2, RAN4]*

- *Evaluation methodology for sidelink operation on unlicensed spectrum*
- *Sidelink channel access mechanism for unlicensed spectrum based on regional regulation requirement and use the existing channel success schemes from NR-U as a starting point*
    - *Reuse Rel-16 resource allocation mechanism as much as possible*
- *Required changes to NR sidelink physical channel structures and procedures to operate on unlicensed spectrum*

    - *No specific optimizations for existing NR SL feature*

- *Frequency bands for the unlicensed spectrum in FR1 are 5GHz and 6GHz*
- *No specific optimizations for FR2 unlicensed spectrum*

RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of the work.

Proposal 5 seems to be acceptable to most of the companies. However, at least one company indicated that they do not consider Proposal 5 as high priority in Rel-18.

Proposal 5: *Study enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]*

- *Work is limited to the support of sidelink beam management (including initial beam-pairing, beam maintenance, and beam failure recovery) by enhancing existing sidelink CSI framework and reusing Uu beam management concepts wherever possible.*

RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of the work.

Proposal 6 seems to be acceptable to most of the companies. However, a number of companies indicated that they do not consider Proposal 6 as high priority in Rel-18. Volkswagen preferred to explicitly mention dynamic coexistence mechanism but given some comments from some of the companies, the moderator's view is that it will not be acceptable.

Proposal 6: *Study mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance, necessity, feasibility, and potential specification impact if any [RAN1, RAN2, RAN4]*

- *Reuse the in-device coexistence framework defined in Rel-16 as much as possible*

RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of the work.

Justification text has been revised taking into account the comments received from the companies.

5.2 Summary of proposals

Proposal 1: *For Rel-18 sidelink enhancement, start as a work item with a study phase for a subset of objectives.*

- *For the objectives subject to a study phase, RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of this work.*

Proposal 2 (non-controversial): *For sidelink enhancement, RAN1 is the primary working group. Secondary working groups are RAN2 and RAN4.*

Proposal 3: *Specify mechanism to support NR sidelink CA operation based on LTE sidelink CA operation [RAN2, RAN1, RAN4]*

- *Prioritize supporting LTE sidelink CA features for NR (i.e. SL carrier (re-)selection, synchronization of aggregated carriers, handling the limited capability, power control for simultaneous sidelink TX, packet duplication)*
- *At least for FR1 licensed spectrum and ITS band*
  - *Whether or not to support sidelink CA for FR2 and/or unlicensed band is to be decided in RAN#98 after the relevant studies are done*
- *This feature is backwards compatible in the following regards*
  - *Rel-16 UEs can receive Rel-18 sidelink broadcast/groupcast transmissions with CA for the carriers on which they receive and transmit the corresponding sidelink HARQ feedback.*
  - *Assuming this sidelink functionality would co-exist in the same resource pools as Rel-16/Rel-17 functionalities (e.g., no changes to reservations in SCI, etc.)*

Proposal 4: *Study the support of sidelink on unlicensed spectrum for both mode 1 and mode 2 where Uu operation for mode 1 is limited to licensed spectrum only [RAN1, RAN2, RAN4]*

- *Evaluation methodology for sidelink operation on unlicensed spectrum*
- *Sidelink channel access mechanism for unlicensed spectrum based on regional regulation requirement and use the existing channel success schemes from NR-U as a starting point*
  - *Reuse Rel-16 resource allocation mechanism as much as possible*
- *Required changes to NR sidelink physical channel structures and procedures to operate on unlicensed spectrum*
  - *No specific optimizations for existing NR SL feature*
- *Frequency bands for the unlicensed spectrum in FR1 are 5GHz and 6GHz*
- *No specific optimizations for FR2 unlicensed spectrum*

RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of the work.

Proposal 5: *Study enhanced sidelink operation on FR2 licensed spectrum [RAN1, RAN2, RAN4]*

- *Work is limited to the support of sidelink beam management (including initial beam-pairing, beam maintenance, and beam failure recovery) by enhancing existing sidelink CSI framework and reusing Uu beam management concepts wherever possible.*

RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of the work.

Proposal 6: *Study mechanism(s) to enable co-channel coexistence for LTE sidelink and NR sidelink including performance, necessity, feasibility, and potential specification impact if any [RAN1, RAN2, RAN4]*

- *Reuse the in-device coexistence framework defined in Rel-16 as much as possible*

RAN to determine in RAN#98 whether or not there is to be specification support in Rel-18 and if there is specification support, the scope of the work.

Proposal on justification:

In Rel-16, sidelink communication was developed in RAN mainly to support advanced V2X applications. In Rel-17, SA2 studied and standardized Proximity based service including public safety and commercial related service. As part of Rel-17, power saving solutions (e.g partial sensing, DRX) and inter-UE coordination have been developed in RAN1 and RAN2 to improve power consumption for battery limited terminals and reliability of sidelink transmissions.

Although NR sidelink was initially developed for V2X applications, there is growing interest in the industry to expand the applicability of NR sidelink to commercial use cases. For commercial sidelink applications, two key requirements have been identified:

- *Increased sidelink data rate*
- *Support of new carrier frequencies for sidelink*

Increased sidelink data rate is motivated by applications such as sensor information (video) sharing between vehicles with high degree of driving automation. Commercial use cases could require data rates in excess of what is possible in Rel-17. Increased data rate can be achieved with the support of sidelink carrier aggregation and sidelink over unlicensed spectrum. Furthermore, by enhancing the FR2 sidelink operation, increased data rate can be more efficiently supported on FR2. While the support of new carrier frequencies and larger bandwidths would also allow to improve its data rate, the main benefit would come from making sidelink more applicable for a wider range of applications. More specifically, with the support of unlicensed spectrum and the enhancement in FR2, sidelink will be in a better position to be implemented in commercial devices since utilization of the ITS band is limited to ITS safety related applications.

Another aspect to consider is the V2X deployment scenario where both LTE V2X and NR V2X devices are to coexist in the same frequency channel. For the two different type of devices to coexist while using a common carrier frequency, it is important that there is mechanism to efficiently utilize resource allocation by the two technologies without negatively impacting the operation of each technology. This requirement was also mentioned as part of the input from 5G Automotive Association to the Rel-18 RAN Workshop.