**3GPP TSG RAN WG1 #106bis-e R1-210xxxx**

**e-Meeting, October 11th – 19th, 2021**

**Agenda item:** 8.17.11

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** [draft] Summary on UE features for NR sidelink enhancement

**Document for:** Discussion and Decision

# **Introduction**

This document summarizes contributions submitted to AI 8.17.11 regarding UE features for NR sidelink enhancement and captures the following email discussion.

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| [106bis-e-R17-UE-features-Sidelink-01] Email discussion UE features for NR sidelink enhancements – Shinya (DOCOMO)* 1st check point: October 14
* Final check point: October 19
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In the preliminary RAN1 UE features list for Rel-17 NR [1], there are following feature groups for NR sidelink enhancement.

* 32-1 [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB]
* 32-2 [Receiving NR sidelink of PSFCH/S-SSB only]
* 32-3 Transmitting NR sidelink mode 2 with full sensing
* 32-4 Transmitting NR sidelink mode 2 with partial sensing
* 32-5 Inter-UE coordination in NR sidelink mode 2

Also, in the preliminary RAN1 UE features list for Rel-17 LTE [2], there are following feature groups for NR sidelink enhancement.

* 4-1 [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB]
* 4-2 [Receiving NR sidelink of PSFCH/S-SSB only]
* 4-3 Transmitting NR sidelink mode 2 with full sensing
* 4-4 Transmitting NR sidelink mode 2 with partial sensing
* 4-5 Inter-UE coordination in NR sidelink mode 2

Based on the discussions summarized in Sections 2-5, following is the suggested list of issues to be discussed and priority order considering RAN2 impact especially for capability signaling design, which are tagged and colour coded with High priority, Medium priority, or Low priority.

**FL proposal of list of issues/proposals and priority:**

* **High priority issues (such as a certain FG is necessary or not):**
	+ **Discuss whether/how to compose of an FG including some SL Tx/Rx capabilities**
		- **Potential Tx capabilities**
			* **mode 2 with random resource selection**
			* **mode 2 with partial sensing (FG 32-4)**
			* **mode 2 with full sensing (FG 32-3)**
		- **Potential Rx capabilities**
			* **SL reception Type A**
			* **SL reception Type B (FG 32-2)**
				+ **Whether to split PSFCH and S-SSB receptions**
			* **SL reception Type D (FG 32-1)**
	+ **Discuss the relationship between the FGs 32-1 to 32-4 and Rel-16 basic FGs for NR SL**
	+ **Discuss** **whether FGs 32-1 to 32-4 should be supported as basic FGs for Rel-17 SL enhancement**
	+ **Discuss** **whether/how to split FG 32-5**
	+ **Discuss** **whether FG 32-5 should be supported as a basic FG for Rel-17 SL enhancement**
	+ **Discuss** **whether Rel-17 UE features for SL enhancement should be included in the LTE features list**
	+ **Discuss** **whether to add and FG for reevaluation of selected resources**
	+ **Discuss** **whether to add and FG for preemption checking for reserved resources**
* **Medium priority issues (such as components and type that have capability signaling impacts):**
	+ **Discuss whether the type of FGs 32-1 to 32-4 should be per band or per FS**
	+ **Discuss** **whether the column of “Need for the gNB to know if the feature is supported” for FGs 32-1 to 32-4 should be “Yes”**
	+ **Discuss** **whether the column of “Applicable to the capability signalling exchange between UEs (Sidelink WI only)” for FGs 32-1 to 32-4 should be “No”**
	+ **Discuss** **whether the type of FG 32-5 should be per UE, per band, or per FS**
	+ **Discuss** **whether the column of “Need for the gNB to know if the feature is supported” for FG 32-5 should be “Yes”**
	+ **Discuss** **whether the column of “Applicable to the capability signalling exchange between UEs (Sidelink WI only)” for FG 32-5 should be “Yes”**
* **Low priority issues (such as components that do not have capability signaling impacts)**
	+ **Discuss whether/how to revise the prerequisite feature groups for FGs 32-1 to 32-4**
	+ **Discuss** **whether/how to revise any other contents in FGs 32-1 to 32-4 which do not have capability signaling impacts**
	+ **Discuss** **whether/how to revise the prerequisite feature groups for FG 32-5**
	+ **Discuss** **whether/how to revise any other contents in FG 32-5 which do not have capability signaling impacts**

In this round of the discussion, companies are requested to provide comments on the proposals and questions tagged FL1.

# **32-1 to 32-4 for NR: Receiving NR sidelink / Transmitting NR sidelink mode 2**

In [1], FGs 32-1 to 32-4 are captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 32. NR\_SL\_enh | 32-1 | [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB] | 1) UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB. | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | 1) UE can receive NR PSFCH/S-SSB only. | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-3 | Transmitting NR sidelink mode 2 with full sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by NR Uu or preconfiguration.2) UE supports the sensing and resource allocation operation as specified in Rel-16. | [32-1] | [Yes] | [No] | [UE can perfom random resource selection only] | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | [32-1], [32-3] | [Yes] | [No] | UE does not support trasmissoin according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

Following feedbacks are provided in contributions for the RAN1#106bis-e meeting.

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| [2] | FUTUREWEI | Based on the following conclusions in RAN1#103-e and in RAN1#104-e, three types of UEs are supported as a reference for evaluation/design in Rel-17, i.e., Type A, Type B, and Type D UEs.***Conclusion:* (RAN1#103-e)*** *SL reception Type A and Type D should be used as the reference for evaluation and designing of SL power saving features in R17.*
	+ *Type A: UE is not capable of performing reception of any SL signals and channels, FFS with exception of performing PSFCH and S-SSB reception (aim to conclude in RAN1#104-e)*
	+ *Type D: UE is capable of performing reception of all SL signals and channels defined in R16. It does not preclude UE to perform reception of a subset of SL signals/channels*
	+ *If there are evaluations with assumptions other than the above reference, the detailed assumptions need to be reported*
	+ *Note: the types and the associated capability defined here are not intended to be defined as Rel-17 UE features as is.*

***Conclusion:* (RAN1#104-e)*** *PSFCH reception is not included for Type A UE*
* *S-SSB reception is not included for Type A UE*
* *SL reception Type B is additionally added*
	+ *Type B: Same as Type A with an exception of performing PSFCH and S-SSB reception*
* *Note: the same conditions as in RAN1#103-e regarding the context of the discussion of Type A and Type D still apply (also applicable to type B)*

Clearly, the proposed features 32-1 and 32-2 in [4] are corresponding to Type D and Type B UEs, respectively. Type A UE is (possibly) indicated by a UE not supporting either FG 32-1 or 32-2. However, there are some issues with these two FGs. First, it is not clear that three types of UEs and associated capability are eventually the agreed Rel-17 UE capabilities or UE features, as in the conclusions, the three SL reception types are used as the reference for evaluation and designing of SL power saving features in R17. There were no follow-up discussions and agreements on these three reception types and UE capabilities. It can be interpreted as these three reception types are different power saving reception modes, not different types of UEs. Also based on the following agreement in RAN1#106-e on SL DRX, it may imply that all UE can perform reception and therefore only Type D is supported as a UE feature if it is applied to all UEs that support Rel-17 SL power saving features.**Agreement**: **(RAN1#106-e)**A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.* *FFS: When such reception and measurement is performed, whether it is subject to specification, or is up to UE implementation*
* *FFS: Other details*

Based on this, we may not need to specify the UE features for these SL reception types, but rather focus on the RRC parameters and configurations needed for different SL reception types as different power saving modes.Second, based on the WID in [3], the objective for power saving is to introduce sidelink random resource selection and partial sensing to Rel-16 NR sidelink resource allocation mode 2. Also, it is included in the WID that enhancements introduced in Rel-17 should be based on the functionalities specified in Rel-16. The WID indicates that Rel-16 NR sidelink resource allocation mode 2 is the prerequisite of the power saving features for Rel-17 sidelink. Based on the latest Rel-16 UE features in [5], the feature of sidelink resource allocation mode 2 is defined as UE FG 15-3, which includes full sensing feature (component 4) indicating capability of PSCCH reception. Moreover, the prerequisite of UE FG 15-3 is FG 15-1 which include the SL reception of PSCCH/PSSCH and PSFCH. If the Rel-16 SL features are pre-requisites of Rel-17 SL features, it is not necessary to define the UE features as FGs 32-1 and 32-2 in [4].Third, if FGs 32-1 and 32-2 in [4] are new UE features or new UE capabilities for power saving to be included in Rel-17, it means that some of Rel-16 SL features are not supported for Rel-17 UEs, e.g., for 32-2, the UE receptions in 15-1 and full sensing in 15-3 are not supported. However, a UE which supports 32-1 shall support some other components in FG 15-3 for mode 2 transmissions, as well as some feature components in 15-1 such as PSFCH reception. Therefore, since by the default, Rel-16 SL features cannot be used as prerequisites for 32-1 and 32-2, the list of components in Rel-16 sidelink FGs should be detailed and listed as the prerequisites for these new features in Rel-17.Finally, the random resource selection in any resource pool (rather than just the exception pool) is new feature that should be included in Rel-17. Random resource selection support in unclear in 32-1/32-2, and as written a UE that supports full sensing in 32-3 of [4] may be disallowed from using random resource selection.Therefore, to resolve the above issues, our preference is *not* to define Type A (UE not capable of receiving any NR sidelink signals and channels) and Type B (UE receiving NR sidelink of PSFCH/S-SSB only) as new UE features (types) in Rel-17. We can specify Type A and Type B as different power saving modes for the UE configured by RRC signalling. For Type D, UE receiving NR sidelink of PSCCH/PSSCH/PSFCH/S-SSB, it specifically means that the UE supports Rel-16 sidelink mode-2. We then add one or more Rel-17 PS features on top of Type D, for example, random resource selection. Then instead of including Type D as a new feature row in the table, we properly list Rel-16 sidelink mode 2 as the *prerequisite feature* for the Rel-17 power saving features. In summary, reasons for “type D only” can be summarized as follows.1. The WID is exactly written in the manner that rel-17 sidelink enhancement is an enhancement of Rel-16 NR sidelink resource allocation mode 2.
2. No agreement so far can be read as explicitly agreeing to add a UE that cannot perform some Rel-16 SL mode-2 basic features/components but not all.
3. No need to examine and possibly redefine Rel-16 functionality other than sensing.

We therefore have the following proposal for the UE SL features for Rel-17 sidelink enhancements.***Proposal: the following UE sidelink features are the list of new sidelink features to be included in Rel-17 for sidelink enhancement:**** ***32-1: Transmitting NR sidelink mode 2 with random resource selection with UE FG 15-3 as the prerequisite FG.***
* ***32-2: Transmitting NR sidelink mode 2 with partial sensing with UE FG 15-3 as the prerequisite FG.***
* ***33-3: Inter-UE coordination in NR sidelink mode 2 with UE FG 15-3 as the prerequisite FG***

On the other hand, we anticipate that some companies may want to include “no sensing” Type A (UE not capableof receiving any NR sidelink signals and channels) and/or Type B (UE receiving NR sidelink of PSFCH/S-SSB only) in addition to Type D (UE receiving NR sidelink of PSCCH/PSSCH/PSFCH/S-SSB) UEs as in the draft [4]. However, as previously discussed, the Rel-16 FGs/components need to be checked and we need to include the appropriate and detailed Rel-16 FGs/components as the prerequisite feature list for the introduced new features. Also, random resource selection (in any pool, not just the exception pool) should be included as a new feature for all Rel-17 UE types. Though not our preference, here we show the checking and modifications required to go that route.To include these new features, the Rel-16 sidelink mode 2 feature list must be examined in detail. As shown in [5], the UE FGs mandatory for sidelink transmission mode 2 are 15-1, 15-3, 15-4, 15-5, 15-11, and 15-23. We now discuss the new SL features and structures, as well as the required Rel-16 SL UE features/components as pre-requisites for the new feature.First, for the new feature related to Type A/Type B UEs, random resource selections are included as the FG components. For the Type B UE feature, i.e., receiving NR sidelink of PSFCH/S-SSB only, here are the discussions on the related Rel-16 UE features as the pre-requisites of this new feature.* 15-1: For UE SL reception FG 15-1, all are not supported except component 8 as SCS and CP still needs to be reported for PSFCH reception.
* 15-3: All transmission features in FG 15-1 are needed except component 4 for full sensing as the UE with this new feature does not support PSCCH reception.
* 15-4: Synchronization is needed for SL transmission. S-SSB reception is supported in this feature. Therefore, FG 15-4 is supported.
* 15-5: It is not clear for now whether 15-5 is required for this feature as there is no decision or agreement on whether congestion control based on CBR and CR for power saving RA schemes.
* 15-11: This FG is needed as PSFCH reception is supported in this new feature
* 15-23: This FG cannot be supported as UE cannot receive the RSRP report from Rx UE for open loop power control.

This new feature is included as updated FG 32-2 in Table 2, which is the updated based on original proposed feature in [4].For type A UE, the new feature termed as *random resource selection only* is included as the updated FG 32-1 in Table 2. The prerequisites can be based on the prerequisites for the updated FG 32-2 receiving NR sidelink of PSFCH/S-SSB only with further reductions.* 15-1: The FG is not needed as no reception of NR sidelink signals and channels are supported.
* 15-3: Same as the updated FG 32-2, all transmission features in FG 15-1 are needed except component 4 for full sensing as the UE with this new feature does not support PSCCH reception.
* 15-4: Synchronization is needed for SL transmission, but S-SSB reception is not supported in this feature. Therefore, FG 15-4 is supported except the component 1.
* 15-5: It is not clear for now whether 15-5 is required for this feature as there is no decision or agreement on whether congestion control based on CBR and CR for power saving RA schemes.
* 15-11: This FG is not supported as PSFCH reception is not supported in this new feature
* 15-23: Similarly, as before, this FG cannot be supported.

For Type D UE, i.e., the feature of receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB, is included as updated FG 32-3 in Table 2. The random resource selection is included as a component in the FG. The prerequisites include all Rel-16 SL mode 2 features except the component 4 in FG 15-3.The partial sensing feature is listed as FG 32-4 in Table 2. The prerequisite of the partial sensing is Rel-16 full sensing. Therefore, all Rel-16 features are supported. Since it may not be necessary that UE supporting partial sensing also supports random resource selection, the random resource reselection is not included. The FG 32-3 is not listed as the prerequisite of partial sensing either. For simplicity, a UE that supports random resource selection would also support 32-1, 32-2, or 32-3. For the inter-UE coordination feature, it is not necessary that a UE supporting the inter-UE coordination must support the partial sensing feature or vice-versa. However, as both features are in Rel-17, the combination should also NOT be prevented. So, the terminology basic feature group is not used for either as they are both "optional". The pre-requisite for inter-UE coordination is listed as Rel-16 mode 2 basic features. The inter-UE coordination feature is included a as FG 32-5 in Table 2. ***Observation: Supporting “no sensing” type A and/or type B UEs in addition to type D requires careful examination of rel-16 FGs and clear support of random resource selection.**** ***An example is shown in Table 2 of the Appendix.***

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| 32. NR\_SL\_enh | 32-1 | ~~[Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB]~~[Random resource selection only] | 1. UE ~~can receive NR PSCCH/PSSCH/PSFCH/S-SSB.~~  is not capable of receiving any SL signals and channels.
2. UE supports random resource selection
 | ~~None~~15-3 (except component 4),15-4 (except component 1)15-5 (FFS) | [Yes] | [No] |  | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | 1. UE can receive NR PSFCH/S-SSB only.
2. UE supports random resource selection
 | ~~None~~15-1 (component 8 only),15-3 (except component 4),15-4,15-5 (FFS),15-11 | [Yes] | [No] |  | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-3 | ~~Transmitting NR sidelink mode 2 with full sensing~~[Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB] | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by NR Uu or preconfiguration.2) UE supports the sensing and resource allocation operation as specified in Rel-16.3) UE supports random resource selection | ~~[32-1]~~15-1 15-3 (except component 4),15-4,15-5,15-11,15-23 | [Yes] | [No] |  | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | ~~[32-1], [32-3]~~Rel-16 SL mode 2 features | [Yes] | [No] | UE does not support ~~trasmissoin~~ transmission according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-5 | Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | ~~[32-1]~~ Rel-16 SL mode 2 features  | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

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| [4] | vivo | In Rel-16, the following UE features are defined as basic UE feature group for NR sidelink, i.e., should be indicated as “support” by UE if it supports NR sidelink:

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| 15-1 | Receiving NR sidelink  | 1) UE can receive NR PSCCH/PSSCH. Up to a total of A sidelink HARQ processes across all links are supported.2) UE can receive X PSCCH in a slot.3) UE can attempt to decode Y= NRB non-overlapping RBs per slot 4) UE supports reception of PSSCH according to the 64QAM MCS table 5) UE supports PT-RS reception in FR2.8) UE can receive using the subcarrier spacing and CP length defined for a given band in RAN410) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.12) UE can receive using 30 kHz subcarrier spacing with normal CP in FR1, 120 kHz subcarrier spacing with normal CP FR2 |
| 15-2 | Transmitting NR sidelink mode 1 scheduled by NR Uu | 1) UE can transmit PSCCH/PSSCH using dynamic scheduling or configured grant type 1 and 2 in NR sidelink mode 1 scheduled by NR Uu. Up to 8 configured grants can be configured for a UE. Up to C sidelink HARQ processes are supported including those for configured grants2) UE can transmit PSSCH according to the normal 64QAM MCS OFDM table.3) UE supports PT-RS transmission in FR2.4) UE can monitor DCI format 3\_0 for NR sidelink dynamic scheduling and configured grant type 2 on the same carrier as sidelink.6) UE can transmit using the subcarrier spacing and CP length it reports.8) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.9) Support downlink pathloss based open loop power control11) UE can report sidelink HARQ-ACK to gNB via PUCCH and PUSCH when it is operating in NR sidelink mode 1 |
| 15-3 | Transmitting NR sidelink mode 2  | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.2) UE can transmit PSSCH according to the normal 64QAM MCS table.3) UE supports PT-RS transmission in FR2.4) UE can perform mode 2 sensing and resource allocation operations6) UE can transmit using the subcarrier spacing and CP length it reports for FG 15-18) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.10) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR211) DL pathloss based open loop power control when mode 2 is configured by NR Uu |
| 15-4 | Synchronization sources for NR sidelink | 1) UE can receive S-SSB in NR sidelink if it supports 15-1.2) UE can transmit S-SSB in NR sidelink if it supports 15-2 or 15-3.3) UE supports GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to false.4) UE can transmit or receive NR sidelink based on the synchronization to an gNB5) UE additionally supports gNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.6) UE additionally supports gNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. |
| 15-5 | Sidelink congestion control | 1) UE can report CBR measurement to gNB when operating in Mode 1 and mode 2 2) UE can adjust its radio parameters based on CBR measurement and CRlimit.3) UE can process CBR and CR within the time it indicates |
| 15-11 | PSFCH format 0  | 1) UE can transmit and receive NR PSFCH format 02) UE can receive up to N PSFCH(s) resources in a slot.3) UE can transmit up to M PSFCH(s) resources in a slot |
| 15-23 | Support of open loop SL power control and RSRP report | 1. Support sidelink pathloss based open loop power control and RSRP report in case of unicast
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The first question should be clarified is that, whether these Rel-16 basic UE features are still considered as mandatory features for Rel-17 sidelink UE, especially for pedestrian UE. The problem is that some of these features (or sub-features), such as full sensing or PSCCH/PSSCH reception as highlighted above, may not be supported by pedestrian UE. To address the problem, there are several approaches to design the UE features for pedestrian UE in Rel-17:* Alt-1: The Rel-16 basic FG that is not supported for PUE is not mandatory in Rel-17.
* Alt-2: Introduce Rel-17 UE feature to indicate which Rel-16 basic FG is not supported by the PUE.
* Alt-3: Introduce a new basic FG that overrides Rel-16 basic FG.

Alt-1 may resolve this problem for some of the FG (e.g., 15-11), but may not help for the FG where only some component(s) is not applicable (e.g., 15-3). Moreover, it may have some backward compatibility issues, e.g., the Rel-16 network may consider it as an error if a Rel-17 UE does not report some Rel-16 “basic FG”.Alt-2 seems to have less spec impact, but it seems to be not aligned with the following RAN2 guidance [3]:

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| **1 Avoid defining “incapability” bits as they may cause interpretation issues**The definition of the capability should not say that “a UE setting the bit does not support Rel-16 feature X”. Such statements caused a lot of problems in Rel-15. One example was the *pucch-F0-2WithoutFH* that indicates that “the UE does **not** support PUCCH formats 0 and 2 without frequency hopping”.  |

 Alt-3 may have large specification impacts, and may even have impacts on Rel-16 UE implementation. It seems none of the alternatives is the perfect solution. On the other hand, the current preliminary features related to power saving enhancements (e.g., 32-1/2/3/4) are somewhat confusing or problematic. For example, the FG 32-3 indicates that UE supports Rel-16 full sensing, which is duplicated with the Rel-16 FG 15-3. Moreover, the absence of FG 32-3 means that the UE only supports random selection. Consequently, it seems to imply that every Rel-16 UE should indicate FG 32-3, which has backward compatible issue. Considering that the Rel-17 UE features related to power saving enhancements highly depend on how to handle the Rel-16 basic features and how to define UE feature for pedestrian UE, RAN1 should first investigate how the PUE handles the Rel-16 basic FG.*Proposal 1:* *RAN1 should first investigate how the Rel-17 Pedestrian UE (e.g., does not support full sensing) handles the Rel-16 NR sidelink basic UE features.* |
| [5] | OPPO | For the power efficient RA, there should be separate feature group for the followings:* Random resource selection (including enhancements to operate in resource pool with mixed RA schemes, if any) – not yet included as a FG in [2]
	+ Includes both periodic and aperiodic transmissions
	+ Maximum distance separation of 32 logical slots for a HARQ retransmission resource reserved by a prior SCI for the same TB
	+ The minimum HARQ feedback time gap (Z) between any two selected resources of a TB where a HARQ feedback for the first of these resources is expected
* Partial sensing operation in NR sidelink mode-2 resource allocation – FG 32-4 (Transmitting NR sidelink mode 2 with partial sensing) in [2]
	+ Both periodic-based PS and contiguous PS should be included in the same feature group – no separate capability signaling
	+ In PBPS, UE monitors 1 periodic sensing occasion per reservation periodicity by default and monitors one additional periodic sensing occasion by (pre-)configuration (as per current working assumption)
	+ FFS aspects related to re-evaluation and pre-emption checking (e.g., only in the initial period or every reservation period)
	+ FFS aspects related to UE performing partial sensing in during SL-DRX inactive time and initializing candidate resource set to match with SL-DRX ON duration timer
* No feature groups and UE capability bits are needed to define UE with different reception capability (Type A, Type B and Type D), as they were described as part of conclusions intended only to help with technical design of partial sensing schemes. Therefore, FG 32-1 and 32-2 in the preliminary RAN1 UE feature list for Rel-17 NR [2] should be removed.
* On FG 32-3 relating to “transmitting NR sidelink mode 2 with full sensing”, this is a Rel-16 feature. It is not required to define this capability again in Rel-17 UE feature list for NR. Hence, we suggest to remove this FG from the UE feature list as well.
 |
| [6] | Huawei, HiSilicon | Following conclusion was made in RAN1#103-e:***Conclusion**** *SL reception Type A and Type D should be used as the reference for evaluation and designing of SL power saving features in R17.*
	+ *Type A: UE is not capable of performing reception of any SL signals and channels, FFS with exception of performing PSFCH and S-SSB reception (aim to conclude in RAN1#104-e)*
	+ *Type D: UE is capable of performing reception of all SL signals and channels defined in R16. It does not preclude UE to perform reception of a subset of SL signals/channels*
	+ *If there are evaluations with assumptions other than the above reference, the detailed assumptions need to be reported*
	+ *Note: the types and the associated capability defined here are not intended to be defined as Rel-17 UE features as is.*

Following conclusion was made in RAN1#104-e:***Conclusion:**** *PSFCH reception is not included for Type A UE*
* *S-SSB reception is not included for Type A UE*
* *SL reception Type B is additionally added*
	+ *Type B: Same as Type A with an exception of performing PSFCH and S-SSB reception*
* *Note: the same conditions as in RAN1#103-e regarding the context of the discussion of Type A and Type D still apply (also applicable to type B)*

Though RAN1 conclusions on types and the associated capability defined for NR reception are not intended to be defined as Rel-17 UE features, it is good to have those as a starting point for discussion on UE features. In this paper, we refer to those agreed terminology on UE types for discussion.It is noted that a Type A reference UE is with minimized power consumption in terms of reception including sensing, so that it only transmit packets to neighbouring UE via PC5.However, it does not need a specific a FG to report non-reception of all sidelink. Instead, a Rel-17 can report random resource selection FG only (and no Rel-16 V2X FGs) to indicate it receives nothing via sidelink. This is to minimize the amount of capability signaling defined.On Type B reference UE, with reception of SFCH and S-SSB only, a UE can receive PSFCH to utilize sidelink HARQ-ACK information to improve random resource selection performance, and receive S-SSB to synchronize to a discovered source for PSCCH/PSSCH transmission. If RAN1 agrees that such a UE is defined in reality, then it needs a UE capability to inform gNB how to operate in mode 1.With Type D capability, the reference UE can do full sidelink reception including sensing and resource allocation. In this case, a Rel-17 UE can reuse Rel-16 FG 15-1 to indicate this FG, and there is no need to define a new Rel-17 FG.***Proposal 1: For Rel-17 sidelink, the following UE reception capabilities exist:**** ***FG 15-1: Receiving NR sidelink PSCCH/PSSCHP/SFCH/S-SSB (a Type D UE)***
* ***FG 32-2: Receiving NR sidelink PSFCH and S-SSB only (a Type B UE).***
* ***FG 32-4a: Receiving none of NR sidelink PSCCH/PSSCH/PSFCH/S-SSB (a Type A UE).***

Rel-17 introduces partial sensing (including periodic-based partial sensing and continuous partial sensing) and random resource selection to reduce power consumption. All these types of resource allocation schemes need to be part of UE features. A UE which does not support partial sensing nor random resource selection, but which can perform sensing and resource selection as specified in Rel-16 (i.e. full sensing) will indicate a set of Rel-16 FGs including primarily 15-3 and its pre-requisite 15-1, for supporting mode 2 resource allocation. There is no need to redefine it as a Rel-17 FG. To do so creates problem of dissociating the full sensing in Rel-17 from the basic FGs of Rel-16 which necessarily go with it, such as PSFCH support, etc., or of unnecessarily repeating all such FGs in the Rel-17 list.***Proposal 2: Support the following Rel-17 UE features in terms of resource allocation schemes:**** ***FG 32-4: Transmitting NR sidelink mode 2 with partial sensing, including both periodic-based and continuous partial sensing.***
* ***FG 32-4a: Transmitting NR sidelink mode 2 with random resource selection.***
* ***No Rel-17 FG is needed for full sensing capability. A UE supporting full sensing reports the required set of Rel-16 basic FGs including FG 15-3 (“Transmitting NR sidelink mode 2”), etc.***

Based on RAN1 agreements that resource allocation schemes (full sensing, partial sensing, and random resource selection) are configured per resource pool, thus it is essential for gNB to be aware of the UE features on what resource allocation schemes it supports. For inter-UE coordination, it is also agreed that features for both scheme 1 and scheme 2 can be enabled or disabled or controlled by (pre-)configuration, and therefore gNB should be informed with UE capability.***Proposal 4: UE features regarding resource allocation schemes and inter-UE coordination schemes need to be informed to gNB.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | 1) UE can receive NR PSFCH/S-SSB only. | None | Yes | [No] |  | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | [32-1] | Yes | [No] | UE does not support transmission according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-4a | Transmitting NR sidelink mode 2 with random resource selection | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with random resource selection configured by NR Uu or preconfiguration. | None | Yes | [No] | UE does not support transmission according to the random resource selection and resource allocation | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

 |
| [7] | CATT | **FG 32-1: [Receiving NR sidelink of PSCCH/PSSCH/PSFCH/S-SSB]**This feature group has been supported in Rel-16 NR-V2X by default, nothing is new for Rel-17 sidelink. Therefore, this feature group is not necessary.***Proposal 1: FG 32-1 is not necessary in Rel-17 sidelink enhancement due to the fact that it is already supported in Rel-16 sidelink by default.*****FG 32-2: [Receiving NR sidelink of PSFCH/S-SSB only]**This feature group is necessary, especially for UE with low cost and low capability. From synchronization perspective, the S-SSB reception is necessary for any UE type. PSFCH reception is not larger burden for UE capability, and can potentially improve the packet reliability. Therefore, it is better bundle S-SSB and PSFCH reception in one FG. If this FG is not indicated, UE will be support all the sidelink receptions by default. ***Proposal 2: FG 32-2 is necessary in Rel-17 sidelink enhancement, and it is preferred to bundle S-SSB and PSFCH reception into one FG.*****FG 32-3: Transmitting NR sidelink mode 2 with full sensing**Similar comment as that in FG32-1, this feature group has been supported in Rel-16 NR-V2X by default, nothing is new for Rel-17 sidelink. Therefore, this feature group is not necessary.***Proposal 3: FG 32-3 is not necessary in Rel-17 sidelink enhancement due to the fact that it is already supported in Rel-16 sidelink by default.*****FG 32-4: Transmitting NR sidelink mode 2 with partial sensing**The partial sensing is introduced in Rel-17, and both periodic-based partial sensing and contiguous partial sensing should be bundled into one FG. ***Proposal 4: FG 32-4 is necessary in Rel-17 sidelink enhancement.*** |
| [8] | Xiaomi | *On UE receiving capability*In [1], there are 2 features on UE receiving capability;* 32-1 UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB
* 32-2 UE can receive NR PSFCH/S-SSB only

In addition to the two features, an additional UE receiving capability should be defined to support UEs without sidelink receiving capacity but only sidelink transmitting capability. **Proposal 1: An additional UE feature should be defined to support UEs not capable of performing reception of any SL signals and channels.***On UE transmitting capability*In [1] there are two transmission related features defined:* 32-3 Transmitting NR sidelink mode 2 with full sensing
* 32-4 Transmitting NR sidelink mode 2 with partial sensing

Now 32-3 is defined as the pre-request of 32-4. This implies that there would be no UE which can perform partial sensing but cannot perform full sensing. However, for some use cases such as V2P, it would be beneficial to define some UEs e.g. pedestrian UEs, to support only partial sensing based resource (re)selection such that the power consumption of these UEs can be saved. Therefore, it is suggest to revise 32-3 to have only 32-1 as the pre-request, and then a UE can support partial sensing or full sensing with independent capability.**Proposal 2: Only feature 32-1 is defined as the prerequisite feature of feature 32-4**  |
| [9] | Samsung | **Feature 32-3: Transmitting NR sidelink mode 2 with full sensing**1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by NR Uu or preconfiguration.2) UE supports the sensing and resource allocation operation as specified in Rel-16.**Feature 32-4: Transmitting NR sidelink mode 2 with partial sensing**1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation.However, Feature 32-3 (Full sensing only) cannot be a Rel-17 UE feature since Rel-17 NR sidelink enhancement considers resource allocation for power saving. In other word, full sensing alone is a Rel-16 UE feature and a Rel-17 UE feature needs to include at least one of the resource allocation schemes for power saving. In RAN1#103-e meeting [3], the following agreements were made as:* *Partial sensing based RA is supported as a power saving RA scheme*
	+ *FFS details*
* *Random resource selection is supported as a power saving RA scheme*
	+ *FFS any changes or enhancement*
	+ *FFS on conditions to apply random resource selection*
* *In R17, a SL Mode 2 Tx resource pool can be (pre-)configured to enable full sensing only, partial sensing only, random resource selection only, or any combination(s) thereof*
	+ *FFS details, including usage, potential restrictions, whether/how any enhancement or condition is needed for the coexistence of full sensing and power saving RA scheme(s) in a same resource pool, etc.*

Therefore, we need to include at least partial sensing or random selection as a Rel-17 UE feature for transmitting NR sidelink Mode 2. Considering the possible combination of {full sensing, partial sensing, random selection}, we propose that the following combinations are supported as the Rel-17 UE feature for transmitting NR sidelink Mode 2.***Proposal 1:*** *The following UE features are supported for transmitting NR sidelink Mode 2 as:** *Transmitting NR sidelink Mode 2 with full sensing, partial sensing and random*
* *Transmitting NR sidelink Mode 2 with partial sensing and random selection only*
* *Transmitting NR sidelink Mode 2 with random selection only*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-3 | Transmitting NR sidelink mode 2 with full sensing, partial sensing, and random selection | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing, partial sensing, and random selection configured by NR Uu or preconfiguration.2) UE supports the sensing and resource allocation operation as specified in Rel-16.3) UE can perform periodic-based partial sensing and resource allocation operation.4) UE can perform contiguous partial sensing and resource allocation operation.5) UE can perform random selection based resource allocation operation. | [32-1] | [Yes] | [No] | [UE can perfom random resource selection only] | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-4 | Transmitting NR sidelink mode 2 with partial sensing and random selection | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing and random selection configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation.4) UE can perform random selection based resource allocation operation. | [32-1]~~, [32-3]~~ | [Yes] | [No] | UE does not support trasmissoin according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-5 | Transmitting NR sidelink mode 2 with random selection | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with random selection configured by NR Uu or preconfiguration.2) UE can perform random selection based resource allocation operation. | [32-1] | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

 |
| [10] | MediaTek | As listed in the preliminary RAN1 UE features for sidelink enhancements [1], SL power saving-related UE features include UE reception capabilities and sensing capabilities. In Rel-17 SL enhancements WI, progress has been made to define different sidelink UE types (i.e., Type-A, Type-B, and Type-D), for at least evaluation purposes, depending on the capability of receiving different sidelink physical channels. According to RAN1 agreements, Type-A UE cannot receive any sidelink PHY channel while Type-B UE can only receive S-SSB/PSFCH and Type-D UE can receive all PHY channels. As defined in [1], UE feature index 32-1 and 32-2 together can facilitate the functionality of Type-A, Type-B, or Type-D UEs when both 32-1 and 32-2 are defined as optional. See the corresponding functionality in Table I for possible UE reception capabilities depending on UE’s support. **Table I. Corresponding UE types depending on UE reception capability.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Type-D UE** | **Type-B UE** | **Type-A UE** |
| 32-1 | [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB] | Yes | No | No |
| 32-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | n/a | Yes | No |

In our view, the feature groups 32-1 and 32-2 offer good flexibility in terms of UE’s reception capability. Both 32-1 and 32-2 need to be reported to the gNB while sidelink UE may not need to be informed about peer UE reception. Our view on feature groups 32-1 and 32-2 are summarized in Table II with highlighted change marks. **Table II. Feature group 32-1 and 32-2 for sidelink UE reception capability.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | Mandatory/Optional |
| 32-1 | ~~[~~Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB~~]~~ | 1) UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB. | None | ~~[~~Yes~~]~~ | ~~[~~No~~]~~ | Optional with capability signalling. ~~FFS: For UE supports NR sidelink, UE must indicate this FG is supported.~~ |
| 32-2 | ~~[~~Receiving NR sidelink of PSFCH/S-SSB only~~]~~ | 1) UE can receive NR PSFCH/S-SSB only. | None | ~~[~~Yes~~]~~ | ~~[~~No~~]~~ | Optional with capability signalling. ~~FFS: For UE supports NR sidelink, UE must indicate this FG is supported.~~ |

We have the following proposal on 32-1 and 32-2 regarding UE reception capability for SL power-saving. **Proposal 1: UE feature 32-1 and 32-2 [1] are supported as indicated in Table II above.** Regarding a power-limited TX-UE’s resource selection procedure in UE autonomous mode (i.e., mode-2), RAN1 has so far agreed to define partial sensing and random resource selection operations. Two kinds of partial sensing procedure are agreed in RAN1 as periodic-based and contiguous partial sensing. A power-limited partial-sensing UE should be able to perform either one of these partial sensing schemes, or both of them simultaneously depending on the resource pool configuration and the allowed types of reservations. A UE that does not require power saving can perform full sensing according to Rel-16 sensing procedure. A power limited UE can perform partial sensing or random resource selection depending on reception capability or the necessary level of power saving required by the UE. As defined in [1], feature index 32-3 and 32-4 describe full sensing and partial sensing features as optional. As indicated by 32-4 in [1], a UE that supports partial sensing should be capable of performing both periodic-based and contiguous partial sensing schemes. Our view on feature groups 32-3 and 32-4 are summarized in Table III with change marks below.**Table III. Feature group 32-3 and 32-4 for sidelink UE sensing operation.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | Mandatory/Optional |
| 32-3 | Transmitting NR sidelink mode 2 with full sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by NR Uu or preconfiguration.2) UE supports the sensing and resource allocation operation as specified in Rel-16. | [32-1] | ~~[~~Yes~~]~~ | ~~[~~No~~]~~ | Optional with capability signalling. ~~FFS: For UE supports NR sidelink, UE must indicate this FG is supported.~~ |
| 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | [32-1], ~~[32-3]~~ | ~~[~~Yes~~]~~ | ~~[~~No~~]~~ | Optional with capability signalling. ~~FFS: For UE supports NR sidelink, UE must indicate this FG is supported.~~ |

We have the following proposal on 32-1 and 32-2 regarding UE reception capability for SL power-saving. **Proposal 2: UE feature 32-3 and 32-4 [1] are supported as indicated in Table III above.** |
| [11] | Intel | So far RAN1 has not had much discussion regarding support of dedicated FG 32-2. In our view FG 32-2 can be merged as a component of FG 32-1. The functionality to receive PSFCH and S-SSB can be beneficial for UE power saving especially for the case of random resource selection with sidelink HARQ enabled but it does not need to be a separate FG. Therefore, we have following proposal:* + **Delete FG 32-2 and define FG 32-1 with following component**
		- **UE can be configured to receive NR PSCCH / PSSCH / PSFCH / S-SSB or receive PSFCH / S-SSB only**

|  |  |  |  |
| --- | --- | --- | --- |
| 32-1 | [Receiving NR sidelink of PSCCH/PSSCH/PSFCH/S-SSB] | 1) UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB. | None |
|  |  |  |  |
| 32-3 | Transmitting NR sidelink mode 2 with full sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by NR Uu or pre-configuration.2) UE supports the sensing and resource allocation operation as specified in Rel-16. | [32-1] |
| 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or pre-configuration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation.4) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with random resource selection configured by NR Uu or pre-configuration. | [32-1], [32-3] |

 |
| [12] | ZTE, Sanechips | Based on the following agreement from RAN1#103-e and 104-e,

|  |
| --- |
| **Conclusion*** SL reception Type A and Type D should be used as the reference for evaluation and designing of SL power saving features in R17.
	+ Type A: UE is not capable of performing reception of any SL signals and channels, FFS with exception of performing PSFCH and S-SSB reception (aim to conclude in RAN1#104-e)
	+ Type D: UE is capable of performing reception of all SL signals and channels defined in R16. It does not preclude UE to perform reception of a subset of SL signals/channels
	+ If there are evaluations with assumptions other than the above reference, the detailed assumptions need to be reported
	+ Note: the types and the associated capability defined here are not intended to be defined as Rel-17 UE features as is.

**Conclusion:*** PSFCH reception is not included for Type A UE
* S-SSB reception is not included for Type A UE
* SL reception Type B is additionally added
* Type B: Same as Type A with an exception of performing PSFCH and S-SSB reception
* Note: the same conditions as in RAN1#103-e regarding the context of the discussion of Type A and Type D still apply (also applicable to type B)
 |

Three types of UE shall have corresponding UE capability indication:Type A: UE can not receive PSSCH/PSCCH/PSFCH/S-SSB. Thus UE can only perform random selection only due to lack of sensing results.Type B: UE can receive PSFCH/SSB only. Thus UE can only perform random selection only due to lack of sensing results.Type D: This UE capability can be indicated using Rel-16 legacy signalling.To reflect the above capability, the original 4-1(32-1) needs to be removed and be replaced by the signalling for Type A UE as shown in the following modification

|  |  |
| --- | --- |
| Not receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB | 1) UE can not receive NR PSCCH/PSSCH/PSFCH/S-SSB.2)UE can perfom random resource selection only |
| [Receiving NR sidelink of PSFCH/S-SSB only] | 1. UE can receive NR PSFCH/S-SSB only.
2. UE can perfom random resource selection only
 |

Moreover, it's suggested all the FGs listed shall be optional, thus the note for each FG "the FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported." can be removed.For 4-3(32-3) Transmitting NR sidelink mode 2 with full sensing, it can be indicated already by Rel-16 signalling 15-3, it can be removed.In summary, the following proposal is made1. Adopt the following modification to the relevant FGs

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | [Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)] | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Capability interpretation for mixture of FDD/TDD | Note | Mandatory/Optional |
| 4. (32)[NR\_SL\_enh] | 4(32)-1 | Not receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB | 1) UE can not receive NR PSCCH/PSSCH/PSFCH/S-SSB.2)UE can perform random resource selection only | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. |  | Optional with capability signalling.~~FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported.~~ |
| 4(32)-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | ~~1)UE can receive NR PSFCH/S-SSB only.~~~~2)UE can perform random resource selection only~~ | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. |  | Optional with capability signalling.~~FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported.~~ |
| ~~4(32)-3~~ | ~~Transmitting NR sidelink mode 2 with full sensing~~ | ~~1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by LTE Uu.~~~~2) UE supports the sensing and resource allocation operation as specified in Rel-16.~~ | ~~[4-1]~~ | ~~[Yes]~~ | ~~[No]~~ | ~~[UE can perfom random resource selection only]~~ | ~~[Per band]~~ | ~~N.A.~~ | ~~N.A.~~ |  | Optional with capability signalling.~~FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported.~~ |
| 4(32)-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by LTE Uu.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | [4-1], [4-3] | [Yes] | [No] | UE does not support trasmissoin according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. |  | Optional with capability signalling.~~FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported.~~ |
| 4(32)--5 | Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | [4-1] | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. |  | Optional with capability signalling.~~FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported.~~ |

 |
| [13] | LG Electronics | When evaluating/designing the mechanism of resource allocation for the power saving in RAN1, the following three types of UEs were considered. So, in terms of the capability to receive NR SL signal/channel, it seems reasonable to make two FGs, i.e., FG of receiving PSCCH/PSSCH/PSFCH/S-SSB and FG of receiving PSFCH/S-SSB only.* UE is not capable of performing the reception of any SL signals and channels
* UE is only capable of performing the reception of PSFCH and S-SSB
* UE is capable of performing the reception of all SL signals and channels defined in Rel-16

***Proposal 1: Introduce the following two FGs for the capability of NR SL signal/channel reception.**** ***Receiving NR SL of PSCCH/PSSCH/PSFCH/S-SSB (i.e., FG 32-1 in [1])***
* ***Receiving NR SL of PSFCH/S-SSB only (i.e., FG 32-2 in [1])***

From our perspective, as FGs related to the capability of NR SL signal/channel transmission, the FG of transmitting NR SL mode 2 with full sensing and the FG of transmitting NR SL mode 2 with partial sensing can be defined. In principle, since the partial sensing is defined as using only a part of the monitoring occasions of the full sensing, it seems desirable for the latter FG to have the former FG as the prerequisite FG. Also considering that the capability of PSCCH reception is required for the sensing operation, these two FGs need to have the FG of receiving PSCCH/PSSCH/PSFCH/S-SSB as the prerequisite FG. There is no strong technical motivation to make separate FGs for the periodic-based partial sensing and the contiguous partial sensing, respectively. ***Proposal 2: Define the following two FGs for the capability of Mode 2 NR SL signal/channel transmission.**** ***Transmitting NR SL Mode 2 with full sensing (i.e., FG 32-3 in [1])***
* ***Transmitting NR SL Mode 2 with partial sensing (i.e., FG 32-4 in [1])***

***Proposal 3: The FG of transmitting NR SL Mode 2 with partial sensing (i.e., FG 32-4 in [1]) has the FG of transmitting NR SL Mode 2 with full sensing (i.e., FG 32-3 in [1]) as the prerequisite FG.******Proposal 4: The FGs of transmitting NR SL Mode 2 with full sensing (i.e., FG 32-3 in [1]) and NR SL Mode 2 with partial sensing (i.e., FG 32-4 in [1]) have the FG of receiving NR SL of PSCCH/PSSCH/PSFCH/S-SSB (i.e., FG 32-1 in [1]) as the prerequisite FG.*** |
| [14] | Apple | One of the RAN1 objectives in Release 17 NR sidelink enhancement is to specify resource allocation to reduce power consumptions of UEs. In the work on this objective, three types of UEs were defined as the reference for evaluation: Type A UE is not capable of performing reception of any sidelink signals and channels; Type B UE is capable of performing PSFCH and S-SSB reception only; Type D UE is capable of performing reception of all sidelink signals and channels. No UE feature needs to be defined for Type A UE, since there is no UE capability associated with it. It seems from [1] that feature 32-1 is associated with Type D UE and feature 32-2 is associated with Type B UE. We support these two features in general. In feature 32-1, it defines UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB. However, Type D UE is capable of performing reception of not only sidelink channels but also sidelink signals. The sidelink signal includes sidelink CSI-RS. Note that sidelink CSI report is a separate Release 16 UE feature. Hence, it may specify that Type D UE is capable of receiving NR PSCCH/PSSCH/PSFCH/S-SSB/SL CSI reporting. ***Proposal 1:*** *In feature 32-2, UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB/Sidelink CSI reporting.* In Release 17 sidelink enhancement, partial sensing based resource allocation and random resource selection were agreed. No UE feature needs to be defined for random resource selection since it is assumed that any UE can perform random resource selection. It seems from [1] that feature 32-3 is associated with resource selection with full sensing and feature 32-4 is associated with resource selection with partial sensing. We support these two features in general. In feature 32-3, the consequence if the feature is not supported by the UE is that UE can perform random resource selection only. However, UE not supporting full sensing can perform partial sensing or perform random resource selection. Hence, we prefer to change the consequence to “UE does not support transmission according to full sensing”. ***Proposal 2:*** *In feature 32-3, the consequence if the feature is not supported by the UE is that UE does not support transmission according to full sensing.* In feature 32-4, one prerequisite feature group is 32-3, i.e., UE transmitting NR sidelink mode 2 with full sensing. However, we think this prerequisite UE feature group is not necessary. A UE can only support transmitting NR sidelink mode 2 with partial sensing. ***Proposal 3:*** *In feature 32-4, remove the prerequisite feature groups of 32-3.*  |
| [15] | Qualcomm | In general, many of the new features are impacted by the currently supported featureset, e.g. the ability to process the additional information required for inter-UE coordination could be impacted by support of operations in other bands that would increase the baseband processing effort. Similarly transmitting or receiving such information would be impacted by other reception and transmission. Therefore, we propose that the feature be defined per featureset.Proposal 1: UE features for sidelink enhancements are defined per featureset.A second general note is that the new features are enhancements that could be implemented separately to a large degree. The UE ability to utilize inter-UE coordination information is not related to its ability to perform partial sensing for example. Therefore, we propose to have all the features as optional without being required for a UE that supports NR sidelink. Furthermore, a Release-16 UE that supports NR sidelink but not any of the Release-17 features is still capable of successfully performing sidelink communications and should not be impacted by the introduction of those new features. Proposal 2: UE features for sidelink enhancements are optional and not required of a UE that supports NR sidelink.Release-16 required any sidelink UE capable of transmission in Mode 2 to also be able to perform random resource selection for transmission in the exceptional resource pool. In Release-17, random selection is introduced as a resource selection mode for regular resource pools as well. Any Release-17 UE that can transmit sidelink using Mode 2 should be able to use random selection since it is the simplest form of resource selection. This could be captured directly in specifications without UE capability signaling. Then, there is no need to mention random resource selection as a consequence of not supporting full sensing or partial sensing.Proposal 3: Any Release-17 UE that is capable of Mode 2 sidelink transmission supports random resource selection.In [1], FG 32-2 combined support for receiving PSFCH and S-SSB. However, the two serve different purposes and have different implementation requirements. Therefore, there is no need to group them. We propose to separate them into two FGs. While the gNB would benefit from knowing whether a UE can receive PSFCH or not, the same does not hold for S-SSB reception.FG 32-3 in [1] already exists as FG 15-3 in the UE feature list. There is no need to duplicate the feature.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-1 | [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB] | 1) UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB. | None | [Yes] | [No] |  | [Per FS] | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |
| 32. NR\_SL\_enh | 32-2a | Receiving NR sidelink of PSFCH | 1) UE can receive NR PSFCH. | None | [Yes] | [Yes] |  | [Per FS] | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |
| 32. NR\_SL\_enh | 32-2b | Receiving NR sidelink of S-SSB | 1) UE can receive NR S-SSB. | None | [No] | [No] |  | [Per FS] | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 32. NR\_SL\_enh | 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | None | [No] | [Yes] | UE does not support trasmissoin according to the partial sensing and resource allocation | [Per FS] | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |

 |
| [16] | Nokia, Nokia Shanghai Bell | Detailed comments on UE features are listed below. For reference, the feature list is available in the Annex. * In general it is unclear how the current Rel-16 FGs relate to the proposed Rel-17 FGs. For several Rel-16 FGs it is noted in 38.306 that ”*Support of this feature is mandatory if UE supports NR sidelink*”. In principle this applies to Rel-17 supporting SL as well, and hence this needs to be taken into account in the proposed FGs under this WID. At the same time, Rel-17 defines functionality that is simplified compared to Rel-16 V2X, and hence there may be a need for differentiation on UE FGs too.
* **32-1:**
	+ It is unclear what is the value of adding this particular FG on top of Rel-16 FGs, in particular FG15-1.
* **32-2:**
	+ This FG is currently defined in isolation, not being a pre-requisite to any other FG. It is unclear what functionality is enabled by such FG. Moreover, the considerations above on Rel-16 FGs needs to be considered here as well, as in the current form this FG is essentially an incapability in that context, as it defines what the UE is unable to do compared to a Rel-16 UE supporting SL.
* **32-3, 32-4:**
	+ At least FG15-3 should be added as pre-requisite.

**Proposal: Consider the observations and modifications proposed above for the next version of the corresponding RAN1 UE features list.** |
| [17] | Ericsson | The feature group 32-1 indicates the behaviour of a UE which is capable of receiving all the SL signalling, i.e., similar capability as a Rel-16 UE. On the other hand, the feature group 32-2 indicates a UE with a reduced SL reception capability, i.e., only able to receive the PSFCH and S-SSB. We are supportive of both FG since they are aligned with the agreements and conclusion taken in RAN1.1. Support the inclusion of FG 32-1 and FG 32-2 including its general description.

The feature group 32-3 indicates the full sensing operation that a UE performs similar to NR SL Rel-16 procedure. For the feature group 32-4, the UE is capable of performing partial sensing operation as defined in RAN1 agreements. Following a similar approach as in LTE Rel-14, we support to have separate FGs for full sensing and partial sensing procedures.1. Support the inclusion of FG 32-3 and FG 32-4. FFS details and wording of the FG.

The feature groups 32-3 and 32-4 define the sensing behaviour of the UE when performing mode 2 resource allocation for sidelink. In our view, we need to also include a new feature group to indicate that mode 2 RA for sidelink can be performed without performing sensing. The inclusion of this feature group is also aligned with the following agreement reached in the inter-UE coordination discussion for scheme 1:

|  |
| --- |
| **Agreement**In scheme 1, at least following UE-B’s behavior in its resource (re-)selection is supported when it receives inter-UE coordination information from UE-A:* For preferred resource set, the following two options are supported:
	+ Option A): UE-B’s resource(s) to be used for its transmission resource (re-)selection is based on both UE-B’s sensing result (if available) and the received coordination information
		- UE-B uses in its resource (re-)selection, resource(s) belonging to the preferred resource set in combination with its own sensing result
			* UE-B uses in its resource (re-)selection, resource(s) not belonging to the preferred resource set when condition(s) are met
				+ FFS: Details of condition(s)
			* This option is supported when UE-B performs sensing/resource exclusion
			* FFS: Other details (if any)
	+ Option B): UE-B’s resource(s) to be used for its transmission resource (re-)selection is based only on the received coordination information
		- UE-B uses in its resource (re-)selection, resource(s) belonging to the preferred resource set
			* This option is supported at least when UE-B does not support sensing/resource exclusion
				+ FFS: Whether the support is conditional or UE capability
			* FFS: Other details (if any)
 |

As indicated in the text marked in yellow, a UE that it is not capable of performing sensing/resource exclusion should indicate this capability to the other UEs in order to be participant of the inter-UE coordination under certain circumstances. Therefore, we propose to include an FG indicating this capability.1. Include a new FG to indicate that a UE can perform transmission in NR sidelink mode 2 without sensing.
 |

## **Discussion**

**[FL1] High priority question 2-1:**

* **Companies are encouraged to provide views on whether/how to compose of an FG including some SL Tx/Rx capabilities**
	+ **Potential Tx capabilities**
		- **mode 2 with random resource selection**
		- **mode 2 with partial sensing (FG 32-4)**
		- **mode 2 with full sensing (FG 32-3)**
	+ **Potential Rx capabilities**
		- **SL reception Type A**
		- **SL reception Type B (FG 32-2)**
			* **Whether to split PSFCH and S-SSB receptions**
		- **SL reception Type D (FG 32-1)**

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | “Mode 2 with full sensing” and “SL reception Type D” are both features included in the Release-16 feature list and there is no need to duplicate them here.We prefer to have random resource selection be captured as part of specifications and be implemented by all Release-17 UEs.PSFCH and S-SSB reception serve different purposes and have different, unrelated implementation requirements. Therefore, we propose to capture them as separate FGs.Finally, we propose not to use the Type A/B/D terminology in the feature list per the agreement notes.* + **Potential Tx capabilities**
		- **mode 2 with random resource selection (in specifications)**
		- **mode 2 with partial sensing (FG 32-4)**
		- **~~mode 2 with full sensing (FG 32-3)~~**
	+ **Potential Rx capabilities**
		- **No SL reception ~~Type A~~**
		- **SL reception ~~Type B~~ of PSFCH (FG 32-2)**
		- **SL reception of S-SSB (new FG)**
		- **~~SL reception Type D (FG 32-1)~~**
 |
| NTT DOCOMO | Mode 2 full sensing, SL RX type D are included in Rel-16, so corresponding new FG would be unnecessary. Rather, they are mandated in Rel-16, so we need to discuss how to handle the FGs.We think one FG for random selection is needed since Rel-16 does not have the feature. “mandatory”-like rule is fine for us if possible.Regarding Type A, type A can be represented by not indicating support of type B and type D, so new FG for type A is unnecessary. For type B, we are fine with the split if majority want. |
| vivo | In our view one or several FGs are needed to represent the SL UEs having different Tx/Rx capabilities. A UE without SL Rx capabilities (i.e., Type A) has been supported since LTE and should also be supported in NR. We are open to consider the detailed signalling design. |
| Samsung | Regarding Tx capabilities, Feature 32-3 (full sensing) by itself cannot be a Rel-17 UE feature since a distinguishing factor for Rel-17 NR sidelink enhancement is resource allocation for power saving. In other words, full sensing alone is a Rel-16 UE feature and a Rel-17 UE feature needs to include at least one of the resource allocation schemes for power saving. Hence we propose the following FG combinations:***Proposal 1:*** *The following UE features are supported for transmitting NR sidelink Mode 2 as:** *Transmitting NR sidelink Mode 2 with full sensing, partial sensing and random*
* *Transmitting NR sidelink Mode 2 with partial sensing and random selection only*
* *Transmitting NR sidelink Mode 2 with random selection only*

Regarding receiving, we believe that having types B and D are sufficient as by default not reporting the support of FG 32-1 and 32-2 will automatically indicate type A. Hence no need to add an additional FG.  |
| ZTE, Sanechips | 1. OK to have Type A/Type B Rx capabilities, but Type D (FG32-1) seems not needed given the basic FG for Rel-16 already supports this kind of capability signaling.Regarding Rx capability of Type B, there is no need to separate PSFCH/S-SSB receptions given there is no agreement on that2. Full sensing indication can be supported by Rel-16 signalling and thus can be removed. Random selection can be a component associated with Type A/B UE. |
| Intel | In our view there is no need to repeat R16 FGs and fragment too much RX capabilities. Therefore, we have following proposal. * + **Potential Tx capabilities**
		- **mode 2 with random resource selection**
		- **mode 2 with partial sensing (FG 32-4)**
		- **~~mode 2 with full sensing (FG 32-3)~~**
	+ **Potential Rx capabilities**
		- **No SL reception**
	+ **Inter-UE coordination capabilities**
		- **Inter-UE coordination scheme 1**
		- **Inter-UE coordination scheme 2**

It is also OK to merge TX capabilities for **mode 2 with random resource selection and mode 2 with partial sensing** |
| Xiaomi | For potential Tx capabilities, “Mode 2 with random resource selection” and “Mode 2 with partial sensing” should be included. “Mode 2 with full sensing” is already supported in Rel-16 and thus does not need to be included in Rel-17 capabilities.For potential Rx capabilities, we prefer to including “No SL reception”.  |
| Huawei, HiSilicon | For Tx capabilities:* For 32-3 (full sensing), it has been defined by R16, no need to re-define in Rel-17. Leave RAN2 to decide how to signal it.
* It is appropriate to define a capability for partial sensing (32-4), and a capability for random selection. Note that Rel-17 should likely have its own FG for random selection rather than rely on the Rel-16 implied specification mandate, because there are or may be procedural differences between the two releases versions of random selection.

For Rx capabilities* Type A is the same as a suitable set of Rel-16 (basic) FGs, and does not require Rel-17 signaling.
* Types B and D – based on what we have seen in the papers, we are fine to not define these as UEs since they were originally introduced simply as design references. If a UE implementation can achieve these ‘types’ by virtue of the Rel-17 features it does / does not implement, that is fine, but does not require additional signaling on top of the supported features.

For Tx and Rx, as per the RAN2 guidance we should not define any ‘incapability’. |
| Lenovo/Motorola Mobility  | Tx capability: Two different UE capability to indicate UE supporting random resource selection and partial sensing otherwise UE can indicate supporting/not supporting partial sensing and full sensing thereby by default supports random selection (according to the agreement)Rx capability: No SL reception and SL Reception of S-SSB only  |

**[FL1] High priority question 2-2:**

* **Companies are encouraged to provide views on the relationship between the FGs 32-1 to 32-4 and Rel-16 basic FGs for NR SL**

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| Company | Comment |
| Qualcomm | Many of the Release-17 SL features are for UEs that do not, or cannot, implement all of the Release-16 basic features. Therefore, we propose to allow a Release-17 to implement a subset, including none, of the Release-16 basic FGs. |
| NTT DOCOMO | Same view as QC. And at the same time, which Rel-16 FGs can be non-basic features should be discussed carefully. |
| vivo | RAN1 should first investigate and clarify how the Rel-17 Pedestrian UE (or Type A/B UE) handles the Rel-16 NR SL basic FGs. For example, 15-11 (PSFCH format 0) is defined as basic FG in Rel-16. Then, is a Rel-17 PUE without Rx capability (i.e., SL Type A UE) allowed to not report 15-11? If it is allowed, then the Rel-16 FGs (e.g., 15-11, 15-4, etc.) can be largely reused, and 32-1, 32-2, etc., are not needed. On the other hand, if the Rel-16 basic FGs are still mandatory for Rel-17 PUE, some solution to indicate the PUE capability is needed. But the current FGs 32-1 to 32-4 may not resolve this issue. When a UE does not report 32-1/2, is it a Rel-16 UE, or a Rel-17 UE with Type A reception? |
| ZTE, Sanechips | FG 32-1 and FG 32-4 can be covered by Rel-16 basic FGs. Instead, an FG covering type D UE should be established as the novel FG32-1. |
| Intel | Our views are summarized in table below:

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| --- | --- | --- |
| 32-1 | [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB] | Same as Rel.16 FG 15-1 Receiving NR sidelink => No need to define |
| 32-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | No need to introduce |
| 32-3 | Transmitting NR sidelink mode 2 with full sensing | Same as Rel.16 FG 15-3 Transmitting NR sidelink mode-2 => No need to define |
| 32-4 | Transmitting NR sidelink mode 2 with partial sensing | Either relates to support of mode-2 transmission or no relationship with Rel.16 FGs, which is also OK  |

 |
| Xiaomi | We agree with QC and DOCOMO to allow Rel-17 to implement only a subset including none of Release-16 basic FGs.  |
| Huawei, HiSilicon | A Rel-17 UE only needs to implement Rel-16 basic FGs, according to which Rel-17 features it supports. The relationship can be best expressed via having Rel-16 FG pre-requisites as needed for Rel-17 FGs. Other points are in reply to Q2-1. |
| Lenovo/Motorola Mobility | Which of the Rel-16 basic FGs should be supported by Rel17 UEs depends on the Rel17 UEs Tx/RX capability  |

**[FL1] High priority question 2-3:**

* **Companies are encouraged to provide views on whether FGs 32-1 to 32-4 should be supported as basic FGs for Rel-17 SL enhancement**

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| --- | --- |
| Company | Comment |
| Qualcomm | No, the features in Release-17 are independent and there is no need to introduce a basic feature group. Any functional dependency could be implemented using the pre-requisites field. |
| NTT DOCOMO | It depends on what is the actual Rel-17 SL FGs. For example, if a FG for type A is introduced, it should be basic FG since lower capable UE will not exist. But if such a FG is not introduced, then basic FG might be unnecessary. |
| vivo | It depends on the answer to question 2-2, for example, are they defined in Rel-17 to “override” the Rel-16 FGs? If yes, they may be considered as basic FGs – but still some revisions are needed. |
| Samsung | Given that Type A and Type B UEs might exist, having FGs 32-1 and 32-2 as basic will require all UEs to perform full sensing. Hence, only FG supporting transmission using random resource selection should be a basic FG. |
| ZTE, Sanechips | The novel 32-1 to 32-4 as in R1-2109733 should not be basic FGs |
| Intel | We do not see strong motivation to define basic FGs for Rel.17 FGs |
| Xiaomi | We do not think the current FGs 32-1 to 32-4 can be basic FGs for Rel-17. We are open to discuss how to define basic FGs for Rel-17. |
| Huawei, HiSilicon | No.A “later” release, in this case wrt Rel-16 NR V2X, should not usually consider basic FGs for a feature because it can delay implementation of unconnected FGs. There need not be any association between implementing inter-UE coordination features and implementing power saving features.This question is properly handled via pre-requisites among inter-UE coordination FGs, once the FGs themselves are clearer. |
| Lenovo/Motorola Mobility  | Depends on the Tx capability indication discussion, UE needs to implement random selection as basic FG if not indicated separately |

**Medium priority question 2-4:**

* **Companies are encouraged to provide views on whether the type of FGs 32-1 to 32-4 should be per band or per FS**

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| Company | Comment |
| Samsung | We prefer to have features 32-1 to 32-4 as per band rather than per FS. This will allow the UE to be more flexible and adapt to the underlying use case. |
| ZTE, Sanechips | Per band should be fine |
| Huawei, HiSilicon | Per band seems reasonable, but we note the proposal of per-FS and would like to understand the reasons more, given that the Rel-17 SL features do not seem related to NR band combinations. |
|  |  |

**Medium priority question 2-5:**

* **Companies are encouraged to provide views on whether the column of “Need for the gNB to know if the feature is supported” for FGs 32-1 to 32-4 should be “Yes”**

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| --- | --- |
| Company | Comment |
| Samsung | Since the focus here is on Mode 2, there is no need for the gNB to know. Thus the answer is No. |
| ZTE,Sanechips | Yes |
|  |  |
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**Medium priority question 2-6:**

* **Companies are encouraged to provide views on whether the column of “Applicable to the capability signalling exchange between UEs (Sidelink WI only)” for FGs 32-1 to 32-4 should be “No”**

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| --- | --- |
| Company | Comment |
| ZTE,Sanechips | For FG 32-1 to 32-3, should be “No”, but for FG32-4, should be “Yes”. |
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**Low priority question 2-7**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 32-1 to 32-4**

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| Company | Comment |
| Samsung | It is essential to limit the prerequisite of FG 32-4 only to FG 32-1. This is because a UE performing partial sensing is not necessarily capable of performing full sensing.  |
| Xiaomi | Only feature 32-1 is defined as the prerequisite feature of feature 32-4 |
|  |  |

**Low priority question 2-8**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 32-1 to 32-4 which do not have capability signaling impacts**

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| Company | Comment |
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# **32-5 for NR: Inter-UE coordination in NR sidelink mode 2**

In [1], FG 32-5 is captured as below.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 32. NR\_SL\_enh | 32-5 | Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | [32-1] | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

Following feedbacks are provided in contributions for the RAN1#106bis-e meeting.

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| [4] | vivo | There are two schemes (and probably several sub-schemes) are being discussed for inter-UE coordination [4]. It is preferable to have separate UE features for different inter-UE coordination (sub-)schemes, considering that these (sub-)schemes are targeting different scenarios.*Proposal 2:* *Separate UE features are defined for different inter-UE coordination schemes.* |
| [5] | OPPO | For the inter-UE coordination RA, there should be a separate feature group for each of the followings. Currently, they are grouped together in FG 32-5 according to [2].* Scheme 1 for preferred resource set
	+ Maybe separate FG for Option A) with sensing capability and Option B) without sensing capability
* Scheme 1 for non-preferred resource set
* Scheme 2 for expected/potential resource conflict
 |
| [6] | Huawei, HiSilicon | There are two inter-UE coordination schemes, where scheme 1 allows to UE-A to indicate a set of resources (preferred or not-preferred) to UE-B, and thus UE-B can perform resource selection according to the coordination information provided by the UE-A, e.g. UE-B is aware of what resources is preferred to be used for transmission. On the other hand, scheme 2 only indicates collision, and UE-B has no information about resource preference and perform resource re-selection on its own sensing results. Thus two schemes can be associated with different UE capability to support different inter-UE coordination operation. Within a scheme, it is not needed to have a number of combinations of different optionss to define different inter-UE coordination capability, because each combination may be optimized in different conditions, such as cast type, group-size, periodic/aperiodic traffic, and a UE is to perform any of them, depending on the situation. In summary, we propose to have two inter-UE coordination UE features, one each for scheme 1 and scheme 2.***Proposal 3: Define inter-UE coordination scheme 1 and scheme 2 as separate UE features, FG 32-5 (scheme 1) and FG 32-6 (scheme 2).***Based on RAN1 agreements that resource allocation schemes (full sensing, partial sensing, and random resource selection) are configured per resource pool, thus it is essential for gNB to be aware of the UE features on what resource allocation schemes it supports. For inter-UE coordination, it is also agreed that features for both scheme 1 and scheme 2 can be enabled or disabled or controlled by (pre-)configuration, and therefore gNB should be informed with UE capability.***Proposal 4: UE features regarding resource allocation schemes and inter-UE coordination schemes need to be informed to gNB.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-5 | Inter-UE coordination scheme 1 in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | 15-1 | Yes | [Yes] | UE does not support inter-UE coordination scheme 1 in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-6 | Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2. | 15-1 | Yes | [Yes] | UE does not support inter-UE coordination scheme 2in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

 |
| [7] | CATT | **FG 32-5: Inter-UE coordination in NR sidelink mode 2**Regarding FG32-5, there are two schemes for inter-UE coordination, i.e. scheme 1 and scheme 2. The two schemes have too much difference on the trigger condition, resource selection procedure and coordination information generation and coordination transmission. Therefore, it would be better to separate the two inter-UE coordination schemes into two FGs, one FG is for inter-UE coordination scheme 1, and another FG is for inter-UE coordination scheme 2.***Proposal 5: FG 32-5 should be separated into two FGs, one FG is for inter-UE coordination scheme 1, and another FG is for inter-UE coordination scheme 2.*** |
| [9] | Samsung | **Feature 32-5: Inter-UE coordination in NR sidelink mode 2**1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set].However, the UE features of transmitting and receiving inter-UE coordination information need to be seperated because some UEs might be able to receive and implement the assistance but not necessarily capable of providing assistance due to their limited sensing capabilities and power restrictions. Moreover, in case of transmitting coordination information, this should also be separated into two features (i.e., the support of Scheme 1 and Scheme 2 should be treated separately). This is because Scheme 2 is much simpler than Scheme 1 and requires only an indication which is unlike providing sets of preferred and non-preferred resources which might require sensing that is beyond the UE’s capability.Therefore, we propose:***Proposal 2:*** *The following UE features are supported for NR sidelink inter-UE coordination information as:** *Transmitting inter-UE coordination Scheme1 in NR sidelink Mode 2*
* *Transmitting inter-UE coordination Scheme2 in NR sidelink Mode 2*
* *Receving inter-UE coordination in NR sidelink Mode 2*

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| 32. NR\_SL\_enh | 32-~~5~~6 | Transmitting i~~I~~nter-UE coordination Scheme1 in NR sidelink mode 2 | 1) UE can transmit ~~and receive~~ inter-UE coordination information of preferred resource set/non-preferred resource set ~~and use the received information in its own resource (re-)selection in NR sidelink mode 2.~~~~2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.~~2) UE can transmit ~~and received~~ an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | ~~[32-1]~~,[32-3 or 32-4 or 32-5] | [Yes] | [Yes] | UE does not support Scheme 1 of inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-7 | Transmitting inter-UE coordination Scheme2 of in NR sidelink mode 2 | 1) UE can transmit inter-UE coordination information of presence of expected/potential resource conflict  | [32-3 or 32-4 or 32-5] | [Yes] | [Yes] | UE does not support Scheme 2 of inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
| 32. NR\_SL\_enh | 32-8 | Receving inter-UE coordination in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can receive an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | [32-1] | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

 |
| [10] | MediaTek | For inter-UE coordination, more details are pending on the discussion. For the explicit, it can be up to further discussion. Our initial view is that component 3) in 32-5 is only applicable for the preferred resource set indication case. For mandatory or Optional, there seems no need to have FFS, i.e., all features can be optional. To be noted, this is the enhancement of NR SL rather than the basic NR SL (R16), no support of this feature won’t break the operation of NR SL. Our view on 32-5 are summarized in Table IV as highlighted in track-change mode.**Table IV. Feature group 32-3 and 32-4 for sidelink UE sensing operation.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | Mandatory/Optional |
| 32. NR\_SL\_enh | 32-5 | Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of preferred resource set | [32-1] | [Yes] | [Yes] | Optional with capability signalling.  |

**Proposal 3: UE feature 32-5 [1] is supported as indicated in Table IV above.** |
| [11] | Intel | In Rel.17, two inter-UE coordination schemes were agreed for sidelink communication (scheme 1 and scheme 2). These schemes have different mechanisms and can operate independently. Therefore FG 32-5 can be divided at least into two FGs:* 32-x5 Inter-UE coordination scheme 1 in NR sidelink mode 2
* 32-y5 Inter-UE coordination scheme 2 in NR sidelink mode 2

Further progress on design needs to be made to decide whether further split is needed. For instance, the FG for inter-UE coordination scheme 1 can be further divided into the following FGs:* Request-based inter-UE coordination with the feedback of preferred resource set
* Request-based inter-UE coordination with the feedback of non-preferred resource set
* Condition-based inter-UE coordination with the feedback of preferred resource set
* Condition-based inter-UE coordination with the feedback of non-preferred resource set

These aspects can be further discussed once more design details are available. At this stage, we have following proposal for inter-UE coordination FG:* + **Split FG 32-5 into two FGs:**
		- **32-x5: Inter-UE coordination scheme 1 in NR sidelink mode 2**
		- **32-y5: Inter-UE coordination scheme 2 in NR sidelink mode 2**
	+ **Further discuss if additional split is needed based on progress of inter-UE coordination framework**

|  |  |  |  |
| --- | --- | --- | --- |
| 32-x5 | Inter-UE coordination scheme 1 in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive an explicit request for inter-UE coordination information of preferred resource set only and/or non-preferred resource set. | [32-1] |
| 32-y5 | Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1. UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.
 | [32-1] |

 |
| [12] | ZTE, Sanechips | Moreover, it's suggested all the FGs listed shall be optional, thus the note for each FG "the FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported." can be removed.In summary, the following proposal is made1. Adopt the following modification to the relevant FGs

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4(32)--5 | Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | [4-1] | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. |  | Optional with capability signalling.~~FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported.~~ |

 |
| [13] | LG Electronics | According to the agreements/working assumptions made so far, there can be up to five variants of the inter-UE coordination by combining the types of resource sets and the triggering conditions in the two schemes (see details below). Since supporting all these variants would be challenging especially considering that each variant may require the distinctive design in its details, we think that RAN1 can prioritize the variants of “signalling of preferred resource set triggered by the explicit request from UE-B” and “signalling of non-preferred resource set triggered by the event/condition at UE-A” for Scheme 1, which will respect the RAN1 conclusion that two types are supported in terms of the resource sets and the triggering conditions. In our understanding, the former is essential to support the preferred resource set for the case where UE-B’s resource(s) to be used for its transmission resource (re-)selection is based only on the received coordination information as UE-A does not know whether the UE-B’s is performing the sensing operation without receiving the explicit request. Note that for Scheme 2, there is no need for the prioritization/down-selection because only one operation has been agreed.* Scheme 1
	+ Signalling of preferred resource set/non-preferred resource set triggered by the explicit request from UE-B
	+ Signalling of preferred resource set/non-preferred resource set triggered by the event/condition at UE-A
* Scheme 2
	+ Signalling of expected/potential resource conflict triggered by the event/condition at UE-A

***Proposal 5: In the inter-UE coordination, prioritize the following variants and defines only the related FGs.**** ***Signalling of preferred resource set triggered by the explicit request from UE-B in Scheme 1***
* ***Signalling of non-preferred resource set triggered by the event/condition at UE-A in Scheme 1***
* ***Scheme 2 as per the current RAN1 agreements***
 |
| [14] | Apple | One RAN1 objective in Release 17 NR sidelink enhancement is to specify inter-UE coordination. Two inter-UE coordination schemes are supported. In inter-UE coordination scheme 1, the coordination information sent from UE-A to UE-B is the set of resources preferred and/or non-preferred for UE-B’s transmission; In inter-UE coordination scheme 2, the coordination information sent from UE-A to UE-B is the presence of expected/potential detected resource conflict on the resources indicated by UE-B’s SCI. It seems from [1] that feature 32-4 is associated with both inter-UE coordination schemes.We think inter-UE coordination scheme 1 and inter-UE coordination scheme 2 are two different UE features. A UE supporting inter-UE coordination scheme 1 does not have to support inter-UE coordination scheme 2, or vice versa. Inter-UE coordination scheme 1 is a proactive scheme, where UE-A provides inter-UE coordination before UE-B’s initial sidelink transmission. Inter-UE coordination scheme 2 is a reactive scheme, where UE-A provides inter-UE coordination after receiving UE-B’s SCI. Although it has not been agreed, it is likely the inter-UE coordination in scheme 1 is carried in PSCCH or PSSCH due to a large number of information bits, while the inter-UE coordination in scheme 2 is carried in PSFCH-like channel due to a small number of information bits. This implies that a UE supporting PSFCH/S-SSB reception only (i.e., feature 32-2) can receive inter-UE coordination in scheme 2. Consider a UE performing random resource selection, can receive inter-UE coordination scheme 2 based on supported feature 32-2. This UE applies the received inter-UE coordination in its resource re-selection. In this way, feature 32-1 is not a necessary prerequisite feature group for the UE receiving inter-UE coordination information of presence of expected/potential resource conflict. On the other hand, a UE transmitting the inter-UE coordination of presence of expected/potential resource conflict needs to have the sensing capability to detect other UEs’ SCI in order to prepare the inter-UE coordination. Hence, the UE needs to receive PSCCH/PSSCH, which makes feature 32-1 as a prerequisite feature group. Hence, it is preferred to separate feature 32-5 according to inter-UE coordination scheme 1 or inter-UE coordination scheme 2 and according to transmitting inter-UE coordination or receiving inter-UE coordination. ***Proposal 4:*** *Separate feature 32-5 according to inter-UE coordination scheme 1 or inter-UE coordination scheme 2, and according to transmitting inter-UE coordination or receiving inter-UE coordination.* ***Proposal 4a:*** *Introduce feature 32-5a for transmitting inter-UE coordination scheme 1, where* * *UE can transmit inter-UE coordination of preferred or non-preferred resource set,*
* *UE can receive explicit request for inter-UE coordination.*

***Proposal 4b:*** *Introduce feature 32-5b is for receiving inter-UE coordination scheme 1, where** *UE can receive inter-UE coordination of preferred or non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2,*
* *UE can transmit explicit request for inter-UE coordination.*

***Proposal 4c:*** *Introduce feature 32-5c for transmitting inter-UE coordination scheme 2, where UE can transmit inter-UE coordination information of presence of expected/potential resource conflict.****Proposal 4d:*** *Introduce feature 32-5d for receiving inter-UE coordination scheme 2, where UE can receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.* * *The prerequisite feature group is either 32-1 or 32-2.*
 |
| [15] | Qualcomm | A single FG is used for all inter-UE coordination features in [1]. However, the ability to utilize preferred resource information is unrelated to the ability to utilize non-preferred resources. Therefore, the FGs for Scheme 1 with preferred resource indication, for Scheme 1 with non-preferred resource indication, and Scheme 2 are separated. Moreover, a UE that utilizes coordination information does not necessarily need to be able to generate coordination information. Hence, those two aspects are listed in separate FGs for each variant.

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| 32. NR\_SL\_enh | 32-5a | Inter-UE coordination preferred resource transmission | 1) UE can generate and transmit inter-UE coordination information of preferred resource set in NR sidelink mode 2.2) UE can receive an explicit request for inter-UE coordination information | None | Yes | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-5b | Inter-UE coordination preferred resource reception | 1) UE can receive inter-UE coordination information of preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit an explicit request for inter-UE coordination information | None | Yes | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-5c | Inter-UE coordination non-preferred resource transmission | 1) UE can generate and transmit inter-UE coordination information of non-preferred resource set in NR sidelink mode 2. | None | Yes | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-5d | Inter-UE coordination preferred nonresource reception | 1) UE can receive inter-UE coordination information of non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2. | None | Yes | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-5e | Inter-UE coordination expected conflict indication transmission | 1) UE can detect the presence of expected/potential resource conflict and transmit an indication for inter-UE coordination in NR sidelink mode 2. | None | Yes | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-5f | Inter-UE coordination expected conflict indication reception | 1) UE can receive inter-UE coordination information indicating the presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2. | None | Yes | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |

 |
| [17] | Ericsson | For this feature group, we propose to split the feature into two different groups due to the different schemes and potential requirements as agreed for inter-UE coordination framework in RAN1:1. The requirements that are needed for each of the Inter-UE coordination schemes agreed in RAN1, i.e., Scheme 1 and Scheme 2, can be different.

We propose to include the following FG 32-5-1 to include the capability for the inter-UE coordination scheme 1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (Sidelink WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 32-5-1 | Inter-UE coordination in NR sidelink mode 2 scheme 1 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | [32-1] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 1 in NR sidelink mode 2. | Per UE | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

We propose to include the following FG 32-5-2 to include the capability for the inter-UE coordination scheme 2.

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (Sidelink WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 32-5-2 | Inter-UE coordination in NR sidelink mode 2 scheme 2 | UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2. | [32-1] [32-2] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 2 in NR sidelink mode 2. | Per UE | N.A. | N.A. | N.A. |  | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |

The motivation of the proposed changes (in red in the tables) is as follows:* In our view, making mandatory that in case a UE supports the inter-UE coordination mechanism, it has to support both schemes is not feasible. Therefore, we propose to divide the FG into two different groups, one for Scheme 1 and another for Scheme 2.
* For Scheme 1 since the coordination message is likely to be included in MAC CE/PC5-RRC or PSSCH, it requires to support the group 32-1 which indicates that the UE is able to receive all of the SL signals.
* For Scheme 2, since the coordination message is likely to be included within the PSFCH resources, i.e., coexisting with the HARQ-ACK resources, then the UE can support this feature by supporting either 32-1 or 32-2.
* The FGs for inter-UE coordination mechanism can be defined per UE.
1. Divide the 32-5 FG into two different FG as defined above to indicate whether the UE supports either Scheme 1 and/or Scheme 2 as agreed in RAN1.
 |

## **Discussion**

**[FL1] High priority question 3-1:**

* **Companies are encouraged to provide views on whether/how to split FG 32-5 into, e.g.,**
	+ **scheme 1**
		- **Request-based inter-UE coordination with the feedback of preferred resource set**
		- **Request-based inter-UE coordination with the feedback of non-preferred resource set**
		- **Condition-based inter-UE coordination with the feedback of preferred resource set**
		- **Condition-based inter-UE coordination with the feedback of non-preferred resource set**
	+ **scheme 2**
	+ **transmitting inter-UE coordination information**
	+ **receiving inter-UE coordination information**

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | We don’t see the need to support request-based non-preferred resource set indication or condition-based preferred resource set indication. We support the remainder split as proposed, i.e. 6 FGs in total:* **Companies are encouraged to provide views on whether/how to split FG 32-5 into, e.g.,**
	+ **scheme 1**
		- **Request-based inter-UE coordination with the feedback of preferred resource set**
		- **~~Request-based inter-UE coordination with the feedback of non-preferred resource set~~**
		- **~~Condition-based inter-UE coordination with the feedback of preferred resource set~~**
		- **Condition-based inter-UE coordination with the feedback of non-preferred resource set**
	+ **scheme 2**
	+ **transmitting inter-UE coordination information**
	+ **receiving inter-UE coordination information**
 |
| NTT DOCOMO | It depends on WI discussion outcome. We are fine with the four separate FGs for scheme 1 when all four patterns are supported in Rel-17 SL.For scheme 2, we are fine with it. |
| vivo | We are fine to have separate FGs for each scheme.  |
| ZTE, Sanechips | OK to have both schemes as component to an FG |
| Intel | If companies prefer to further split on transmitting and receiving inter-UE coordination information, then we suggest the following otherwise we can have FGs for scheme 1 and scheme 2 as starting point:* + **scheme 1 transmitting inter-UE coordination information**
	+ **scheme 1 receiving inter-UE coordination information (including the use of inter-UE coordination information)**
	+ **FFS whether to split scheme 1 on request-based and condition-based feedback for preferred and non-preferred resource sets**
	+ **scheme 2 transmitting inter-UE coordination information**
	+ **scheme 2 receiving inter-UE coordination information (including the use of inter-UE coordination information)**
 |
| Huawei, HiSilicon | As per our submitted proposals – one FG for scheme 1, and another FG for scheme 2.We do not see need for further subdivision: In scheme 1, preferred and non-preferred resource sets are not fundamentally different in terms of UE implementations, and nor are support of condition based vs. request based.It is worthwhile discussing whether to separate inter-UE TX from inter-UE RX capabilities. |
| Lenovo/Motorola Mobiltiy  | We prefer the wording from Intel to separate each scheme as transmitting and receiving while further discussion on request based and condition based can be made once we are clear which of those schemes RAN1 might finally implement, |

**[FL1] High priority question 3-2:**

* **Companies are encouraged to provide views on whether FG 32-5 should be supported as a basic FG for Rel-17 SL enhancement**

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | No, as commented in our reply to 2-3, the features in Release-17 are independent and there is no need to introduce a basic feature group. |
| NTT DOCOMO | Inter-UE coordination would be an optional feature. It cannot be a basic FG. |
| vivo | At least we don’t think it should be a basic FG for power saving UE. |
| Samsung | No this feature should not be a basic FG because it will not be supported by Type A UEs performing only random-based Mode 2 resource selection with no sensing capability. |
| ZTE, Sanechips | Prefer to have this as optional |
| Intel | Optional |
| Xiaomi | Prefer to setting it as optional FG. |
| Huawei, HiSilicon | No.A “later” release, in this case wrt Rel-16 NR V2X, should not usually consider basic FGs for a feature because it can delay implementation of unconnected FGs. There need not be any association between implementing the newly introduced R17 inter-UE coordination features and implementing power saving features.  |
| Lenovo/Motorola Mobility  | Optional  |

**Medium priority question 3-3:**

* **Companies are encouraged to provide views on whether the type of FG 32-5 should be per UE, per band, or per FS**

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Per band is ok with us. |
| ZTE, Sanechips | Per band. |
|  |  |
|  |  |

**Medium priority question 3-4:**

* **Companies are encouraged to provide views on whether the column of “Need for the gNB to know if the feature is supported” for FG 32-5 should be “Yes”**

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | No |
| ZTE, Sanechips | No |
|  |  |
|  |  |

**Medium priority question 3-5:**

* **Companies are encouraged to provide views on whether the column of “Applicable to the capability signalling exchange between UEs (Sidelink WI only)” for FG 32-5 should be “Yes”**

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | Yes for FG supporting Scheme 1. This is because UE B should be aware of the capabilities of UE A before triggering the transmission of resource coordination information. Similarly UE A should be aware that UE B can use the resource coordination information before transmitting it. |
| ZTE, Sanechips | Yes. |
|  |  |
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**Low priority question 3-6**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 32-5**

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| --- | --- |
| Company | Comment |
| Samsung | In general, sensing is needed for UE A to generate and transmit the assistance information. In addition, for UE B, it is essential that is capable of receiving to obtain the coordination information. This can be finalized later once the FGs are decided. |
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**Low priority question 3-7**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 32-5 which do not have capability signaling impacts**

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| Company | Comment |
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# **4-1 to 4-5 for LTE**

In [2], FGs 4-1 to 4-5 are captured as below.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | [Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)] | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Capability interpretation for mixture of FDD/TDD | Note | Mandatory/Optional |
| 4. [NR\_SL\_enh] | 4-1 | [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB] | 1) UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB. | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. |  | Optional with capability signalling.FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported. |
| 4-2 | [Receiving NR sidelink of PSFCH/S-SSB only] | 1) UE can receive NR PSFCH/S-SSB only. | None | [Yes] | [No] |  | [Per band] | N.A. | N.A. |  | Optional with capability signalling.FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported. |
| 4-3 | Transmitting NR sidelink mode 2 with full sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with full sensing configured by LTE Uu.2) UE supports the sensing and resource allocation operation as specified in Rel-16. | [4-1] | [Yes] | [No] | [UE can perfom random resource selection only] | [Per band] | N.A. | N.A. |  | Optional with capability signalling.FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported. |
| 4-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by LTE Uu.2) UE can perform periodic-based partial sensing and resource allocation operation.3) UE can perform contiguous partial sensing and resource allocation operation. | [4-1], [4-3] | [Yes] | [No] | UE does not support trasmissoin according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. |  | Optional with capability signalling.FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported. |
| 4-5 | Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit and receive inter-UE coordination information of preferred resource set/non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.2) UE can transmit and receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.3) UE can transmit and received an explicit request for inter-UE coordination information of [FFS: preferred resource set only or both preferred resource set and non-preferred resource set]. | [4-1] | [Yes] | [Yes] | UE does not support inter-UE coordination in NR sidelink mode 2. | [Per band] | N.A. | N.A. |  | Optional with capability signalling.FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported. |

Following feedbacks are provided in contributions for the RAN1#106bis-e meeting.

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| --- | --- | --- |
| [4] | vivo | The Rel-17 NR sidelink enhancement only targets NR-specific enhancements. There is no impact on LTE sidelink, nor on LTE/NR sidelink interaction. Consequently, there should not be any impact to a Rel-17 UE supporting LTE sidelink only. For a Rel-17 UE supporting both LTE sidelink and enhanced NR sidelink, it should report the Rel-17 related UE features in NR sidelink interface only. Therefore, in our view, the Rel-17 NR sidelink enhancement should have no impact on LTE UE feature.*Observation 1: The Rel-17 NR sidelink enhancement WI has no impact on LTE UE feature.* |
| [13] | LG Electronics | Further discussion is also necessary on whether to define LTE Rel-17 UE feature list for SL enhancement. We think that if LTE Rel-17 feature to support the mechanism of SL enhancement is not introduced, the usability of Rel-17 SL enhancement mechanism will be lower compared to the case of Rel-16 NR V2X. In this sense, our preference is to define LTE Rel-17 UE feature list for SL enhancement.***Proposal 6: Define LTE Rel-17 UE feature list for SL enhancement (i.e., FG 4-1/4-2/4-3/4-4 in [2]).*** |
| [15] | Qualcomm | Some sidelink-related FGs were included for LTE in [2]. In our view, the LTE sidelink feature list can be discussed after the NR FGs are finalized.Proposal 4: Release-17 sidelink related FGs in the LTE UE feature list can be discussed after the NR FGs are finalized. |
| [17] | Ericsson | The list of UE features which are studied and potentially introduced in Rel-17 are only relevant for UEs which use NR Rel-17 technology/procedures. Therefore, there is no need to include or update any of the FG in the LTE feature list.1. There is no need to include or update any of the FG in the LTE feature list. Therefore, we propose to remove all the SL\_enh feature groups included in R1-2108678.
 |

## **Discussion**

**[FL1] High priority question 4-1:**

* **Companies are encouraged to provide views on whether Rel-17 UE features for SL enhancement should be included in the LTE features list**

|  |  |
| --- | --- |
| Company | Comment |
| Qualcomm | The benefit and target scenario for introducing FGs in the LTE feature list aren’t clear to us at this point. We can discussion once more progress has been made on the NR feature list. |
| NTT DOCOMO | Necessity should be clarified. |
| vivo | We don’t see the need of introducing these FGs of NR-specific sidelink enhancements for LTE. |
| Samsung | We prefer to postpone the discussion after NR FGs are completed.  |
| ZTE, Sanechips | OK to further discuss the FGs till NR FGs are stable |
| Intel | Can be discussed later if it is justified |
| Huawei, HiSilicon | We assume yes, on the basis that this means LTE Uu-RRC can configure inter-UE coordination for NR mode 2, for the same reason that LTE Uu can configure Rel-16 NR V2X mode 2. That is – to allow use of inter-UE coordination when NR SL mode 2 is being used in an LTE cell. After checking with our RAN2 colleagues, we do not anticipate difficulty in higher layers to do this.(It does not mean inter-UE coordination between LTE UEs). |
| Lenovo/Motorola mobility  | Can be discussed later, if necessary  |

# **Other FGs**

This section discusses other FGs which are not included in [1] or [2].

Following feedbacks are provided in contributions for the RAN1#106bis-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [15] | Qualcomm | It was already agreed to support reevaluation and pre-emption checking. Two new FGs are introduced for these features.

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| 32. NR\_SL\_enh | 32-6 | Reevaluation of selected resources | 1. UE can perform reevaluation checking for selected but not reserved resources.
 | None | No | No |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-7 | Preemption checking for reserved resources | 1. UE can perform preemption checking for selected resources.
 | None | No | Yes |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling |

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**[FL1] High priority question 5-1:**

* **Companies are encouraged to provide views on whether to add and FG for reevaluation of selected resources**

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| --- | --- |
| Company | Comment |
| Qualcomm | Reevaluation is an important feature to improve the UE’s performance as shown in our evaluation results. However, there are cases when a UE is not capable of performing this operation and therefore, we propose an FG. |
| NTT DOCOMO | We found that Rel-16 SL does not have this capability. Power saving UE might not support re-evaluation/pre-emption check, so these FGs might be needed. But before agreeing this, which feature should be mandated should be discussed first as commented 2-2. |
| vivo | We agree that some power saving UEs may not support re-evaluation/pre-emption, but we share the view with DOCOMO that question 2-2 should be clarified first. |
| Samsung | We don’t see a need for a FG for reevaluation. |
| Intel | Can be discussed further. It needs to be discussed how inter-UE coordination is taken into account for re-evaluation. |
| Huawei, HiSilicon | No. The Rel-17 agreements do not support re-evaluation/pre-emption being optional within partial sensing, and both are mandatory in Rel-16. |
| Lenovo/Motorola Mobility  | Agree with the DOCOMO comment which of the Rel16 feature should be supported by Rel17 UE should be discussed and these re-evaluation&pre-emption are part of those discussion. |

**[FL1] High priority question 5-2:**

* **Companies are encouraged to provide views on whether to add and FG for preemption checking for reserved resources**

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| --- | --- |
| Company | Comment |
| Qualcomm | Similar to reevaluation, there are cases when the UE is incapable of performing preemption checking and therefore, we propose an FG. |
| NTT DOCOMO | Same comment as above. |
| vivo | Please see our comments for question 5-1. |
| Samsung | We don’t see a need for a FG for preemption. |
| Intel | We are open to it especially for the case of partial sensing with semi-persistent transmissions since we indeed see significant power saving trade-offs in this scenario. Otherwise, we need some specification framework on how to handle it. |
| Huawei, HiSilicon | No, as per Q 5-1. |
| Lenovo/Motorola Mobility  | Same comment as above |

# **Conclusions**

TBD

# **References**

[1] R1-2108679 Preliminary RAN1 UE features list for Rel-17 NR Moderators (AT&T, NTT DOCOMO, INC.)

[2] R1-2108678 Preliminary RAN1 UE features list for Rel-17 LTE Moderators (AT&T, NTT DOCOMO, INC.)

[3] R1-2108835 UE features for NR sidelink enhancement FUTUREWEI

[4] R1-2109021 UE features for NR sidelink enhancement vivo

[5] R1-2109066 On UE feature list for NR sidelink enhancement OPPO

[6] R1-2109153 Rel-17 UE features for NR sidelink enhancement Huawei, HiSilicon

[7] R1-2109204 Discussion on Rel-17 UE features for sidelink enhancements CATT, GOHIGH

[8] R1-2109399 Discussion on Rel-17 UE features on sidelink enhancement Xiaomi

[9] R1-2109533 UE features for NR sidelink enhancement Samsung

[10] R1-2109565 Views on UE features for NR sidelink enhancements MediaTek Inc.

[11] R1-2109651 UE features for NR SL enhancement Intel Corporation

[12] R1-2109733 Discussion on UE features for NR sidelink Enhancement ZTE, Sanechips

[13] R1-2109862 Discussion on UE features for NR sidelink enhancement LG Electronics

[14] R1-2110071 Views on NR Sidelink Enhancement UE Features Apple

[15] R1-2110229 UE Features for Sidelink Enhancements Qualcomm Incorporated

[16] R1-2110273 On UE features for NR sidelink enhancement Nokia, Nokia Shanghai Bell

[17] R1-2110342 UE features for NR sidelink enhancement Ericsson