**3GPP TSG RAN WG1 #107-e R1-211xxxx**

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

**Agenda item:** 8.16.11

**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 8.16.11 regarding UE features for NR sidelink enhancement and captures the following email discussion.

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| [107-e-R17-UE-features-Sidelink-01] Email discussion UE features for NR sidelink enhancements – Shinya (DOCOMO)* 1st check point: November 15
* Final check point: November 19
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In the updated RAN1 UE features list for Rel-17 NR after RAN1 #106bis-e [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 updated RAN1 UE features list for Rel-17 LTE after RAN1 #106bis-e [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

The issues to be discussed are tagged and colour coded with High priority, Medium priority, or Low priority, considering RAN2 impact especially for capability signaling design.

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

# **General matters**

This section discusses general matters applicable to all Rel-17 SL FGs.

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [3] | Huawei, HiSilicon | For the all newly defined/introduced UE feature, the support the configuration by network should not be a mandatory since there are PC5 only band at least for ITS band 47. This issue has been treated by added a note in Rel-16 like: “Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1”. We think this principle should also been used for Rel-17.***Proposal 6: A note should be added to the newly defined Rel-17 UE features to treat the supporting of network configuration for PC5 only band cases, e.g.**** ***“Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1”.***
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## **Discussion**

**Medium priority question 2-1:**

* **Companies are encouraged to provide views on whether to add a note to the newly defined Rel-17 SL UE features to treat the supporting of network configuration for PC5 only band cases, e.g.**
	+ **“Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1”**

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| Company | Comment |
| Qualcomm | We agree with the proposal. We’d like to note that our contribution also proposed this wording as part of the changes in Section 23.  |
| NTT DOCOMO | It seems that this proposal is OK as Rel-16 FGs. |
| Huawei. HiSilicon | We assume this would be applied to each FG as with Rel-16. |

# **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#107-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [3] | Huawei, HiSilicon | Rel-17 SL features are designed to allow a Rel-17 UE to not implement all of the Release-16 basic features, e.g. a Type A/B operation does not need to implement Rel-16 FG 15-1 and other FGs taking FG15-1 as pre-requisites. Instead, a Rel-17 UE only needs to implement part of Rel-16 basic FGs if it supports to implement according to Rel-17 features. One example, for inter-UE coordination operation needs to support Rel-16 FG 15-1, i.e. take Rel-16 FG 15-1 as pre-requisite FG for inter-UE coordination FG. ***Proposal 1: Rel-16 basic FGs are not basic FGs in Rel-17. Necessary Rel-16 FGs should be handled via pre-requisites of Rel-17 FGs.***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)*

Following conclusion was made in RAN1#106bid-e:***Agreement****Following Tx capabilities are used as FGs for Rel-17 SL** *mode 2 with random resource selection*
* *mode 2 with partial sensing*
* *FFS: TX capabilities with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection})*

In RAN1#106bis-e, there were discussion on whether it is appropriate to define UE capability signalling reflecting the UE types. In general, it appears after that discussion it is not necessary for Type A and Type D, since the design agreements have not expressed those types in any concrete way beyond references for evaluation. * For Type A

The only Rx operation of Type A is random resource selection without any SL reception, which can be signalled by using newly defined Rel-17 FG “*mode 2 with random resource selection”*, without reporting Rel-16 FG 15-1 *Receiving NR sidelink.* There is no need for separate signalling of a Type A UE.* For Type B

Type B is used to refer to the Rx operation for which a UE does not perform sensing but synchronization and HARQ-based feedback, given that sensing is a major component of power consumption in Rel-16 mode 2 operation. At least from power reduction point view, it is not necessary to further split PSFCH and S-SSB. In Rel-16, reception of each of PSFCH and S-SSB requires Rel-16 FG 15-1 as a prerequisite feature, but random selection only does not need to report Rel-16 FG 15-1. It may not be able to use existing FGs to signal Type B. Thus, if RAN1 decides to have a UE type with PSFCH and S-SSB, there should be a new Rel-17 FG to indicate it, without need of Rel-16 FG 15-1 as prerequisite feature. * For type-D

This Rx operation is same as Rel-16 FG 15-1. No additional signalling is defined for a Rel-17 UE.***Proposal 2:*** * ***No need to introduce an FG to report a Type A UE. It is equivalent to reporting Rel-17 FG “mode 2 random resource selection” without reporting Rel-16 FG 15-1.***
* ***Receiving NR sidelink PSFCH and S-SSB only is indicated by introduction of a new Rel-17 FG.***
	1. ***Do not further split PSFCH and S-SSB into different FGs.***
* ***No need to introduce an FG to report a Type D UE. It is equivalent to reporting Rel-16 FG 15-1.***

Following agreements was made in RAN1#106bis-e [2]:**Agreement**:* *Following Tx capabilities are used as FGs for Rel-17 SL*
	+ *mode 2 with random resource selection*
	+ *mode 2 with partial sensing*
	+ *FFS: TX capabilities with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection})*

. Since the Rel-16 and new Rel-17 RA schemes have been designed to work independently of one another, i.e. there is no need for a UE to support a particular pair of them, the capability signaling can simply allow the UE to indicate each RA scheme separately. Otherwise, a UE may be forced to implement a feature it does not wish to use, only in order to provide the one of interest, e.g. there is no reason to demand random selection be supported when the UE manufacturer is only interested in partial sensing.***Proposal 3: The capability of each RA scheme (full sensing as 15-1, partial sensing, random selection) is reported independently. Do not introduce TX capabilities with more than one sensing scheme.***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 7: UE features regarding resource allocation schemes and inter-UE coordination schemes need to be informed to gNB.***

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|  |  |  |  |  |  |  |  |  |  |  |  | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 |  |
| 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. FFS: For UE supports NR sidelink, UE must indicate this FG is supported. |
|  |  |  |  |  |  |  |  |  |  |  |  | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 |  |
| 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. |  [15-1] | [Yes] | [No] | UE does not support trasmissoin according to the partial sensing and resource allocation | [Per band] | N.A. | N.A. | N.A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. |

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| [4] | 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, proposed features 32-1 and 32-2 in [4] correspond 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 capabilities 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 UEs 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 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 FG 32-2 in [4] is new UE feature or new UE capability 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., the UE reception in 15-1 and full sensing in 15-3 are not supported. Since by the default, entire Rel-16 FGs cannot be used as prerequisites for 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. Note that above we used 32-2 as an example as it is not clear that type D is any different than a Rel-16 UE so 32-1 may not be needed at all, but if it is needed, the prerequisite FGs/components would also need to be analysed and listed.Finally, 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 power saving 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 need to examine and possibly redefine Rel-16 functionality other than sensing.

Based on above discussions, in [6], we proposed the following FGs for the UE features for Rel-17 sidelink enhancements with pre-requisite FG from Rel-16. * *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*

In RAN1#106bis-e, the following UE features are agreed as Tx capabilities.**Agreement**Following Tx capabilities are used as FGs for Rel-17 SL* mode 2 with random resource selection
* mode 2 with partial sensing
* FFS: TX capabilities with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection})

Further, as in Appendix, a working assumption is reached where capabilities of inter-UE coordination schemes 1 and 2 in NR sidelink mode 2 were included in a working assumption but not as the basic FGs for Rel-17 sidelink. The agreement and the working assumption are aligned with our proposal in [6]. The remaining point of difficulty is how to handle the prerequisites. The prerequisite FGs or FG components to support the potential new FGs in Rel-17 were discussed in RAN1#106bis-e. It is a common view that it is not necessary to support all Rel-16 SL basic FG’s for these Rel-17 SL features. However, the proposal was not agreed as companies were not in consensus on whether to identify which Rel-16 SL basic FGs are not mandated to be supported by Rel-17 SL UE, i.e., the direction of “deleting down”, or to identify which Rel-16 SL basic FGs should be supported by Rel-17 SL UE, i.e., the direction of “building up”. However, from our perspective, whether "deleting down" or "building up" is not so critical, the important thing is that any necessary Rel-16 FGs or FG components should be clearly indicated in the Rel-17 FG pre-requisite column to avoid redefining the same FGs/components that are already in Rel-16.***Proposal 1: Any necessary Rel-16 FGs/components will be indicated in the Rel-17 FG pre-requisite column to avoid redefining the same FGs/components already in Rel-16.***Following the discussions above and as in our last proposal, if the Type A/B/D UEs, i.e., FGs under Rx capabilities, are not included as new features, the prerequisite FG for the agreed FGs and the ones for inter-UE coordination in the WA is UE FG 15-3 in Rel-16. Therefore, we have the following proposal.***Proposal 2: Specify UE FG 15-3 as the prerequisite FG of the following agreed new FGs or the FGs in the working assumption for Rel-17 sidelink enhancement:**** ***mode 2 with random resource selection***
* ***mode 2 with partial sensing***
* ***inter-UE coordination schemes 1 and 2***

The FGs based on Rx capabilities were also discussed in RAN1#106bis-e. Under Rx capabilities, some companies 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. 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 Table 3 in Appendix copied from [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 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 15-3 are not needed as Type B UE feature is for receiving capability only.
* 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, 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 15-3 are not needed as Type B UE feature is for receiver capability only.
* 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.

However, as discussed previously, since type D is solely rel-16 mode 2, it seems that the entire FG is not needed.For the agreed random resource selection feature, since it is a transmitter capability, all the UE receiving FGs are not applied. Only transmitting FG 15-3 is applied. Since Type A/B UEs can support random resource selection but not full sensing, to avoid the conflict with features of type A/B UEs, component 4 for full sensing capability in FG 15-3 should be excluded. The random resource selection feature is listed as FG 32-3 in Table 2. The agreed partial sensing feature is listed as FG 32-4 in Table 2. The prerequisite of the partial sensing is Rel-16 full sensing. Since it is a transmit feature, the prerequisite FG is 15-3. 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 as FG 32-5 in Table 2.Note that here no effort was made to best order the FGs, just wanted to show the minimum changes over the original table, Table 1, for the NR sidelink enhancement from [4].***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]~~SL reception Type A  | 1. UE ~~can receive NR PSCCH/PSSCH/PSFCH/S-SSB.~~  is not capable of receiving any SL signals and channels.
 | ~~None~~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 | SL reception Type B [Receiving NR sidelink of PSFCH/S-SSB only] | 1. UE can receive NR PSFCH/S-SSB only.
 | ~~None~~15-1 (component 8 only),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~~Random resource selection  | ~~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.~~1) UE supports random resource selection | ~~[32-1]~~15-3 (except component 4) | [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]~~15-3 | [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. |

 |
| [5] | vivo | In Rel-16, only vehicle UE (VUE) is supported for sidelink. In Rel-17, power limited UE, such as pedestrian UE (PUE), is supported additionally, which is considered less powerful compared with VUE in sidelink operation. It has been agreed that different Tx capabilities may be supported for PUE as follow:

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| **Agreement**Following Tx capabilities are used as FGs for Rel-17 SL* mode 2 with random resource selection
* mode 2 with partial sensing
* FFS: TX capabilities with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection})
 |

On the other hand, the views on Rx capabilities were diverse. In our view, it is necessary to support NR sidelink UE without Rx capability. Such kind of sidelink UE has already been supported from LTE, and has clear market requirement (i.e., at least for automotive use case such as VRU). How to represent this kind of UE can be further studied, e.g., by reporting the UE type (similarly to the RedCap UE), etc.*Proposal 1:* *NR Sidelink UE has no sidelink Rx capability should be supported in Rel-17.*On the other hand, supporting reception of PSFCH is beneficial of achieving higher reliability, while reception of S-SSB is beneficial for SL operation in some scenario out of the coverage of sync source such as GNSS. Nevertheless, the support of PSFCH and S-SSB reception requires an additional RX chain, which should be decided by the UE and indicated to the network. *Proposal 2:* *Rel-17 should support the UE to report the Rx capability of PSFCH and/or S-SSB reception.*Furthermore, unlike the Rel-16 VUE, a PUE supporting random selection and/or partial sensing should not be mandated to support S-SSB transmission, even if it has the Rx capability of S-SSB.*Proposal 3:* *A Rel-17 PUE (i.e., supporting* *random selection and/or partial sensing) should not be mandated to support S-SSB transmission, even if it has the Rx capability of S-SSB.*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. There are several approaches to support pedestrian UE in Rel-17:* Alt-1: The Rel-16 basic FGs are not mandatory for Rel-17 PUE.
* Alt-2: Introduce Rel-17 UE feature to indicate which Rel-16 basic FG is not supported by the PUE.
* Alt-3: Introduce new basic FG that overrides Rel-16 basic FG.

Alt-1 seems to be the most simple and straightforward solution, if the network can properly handle the case where the Rel-17 UE does not report FG that is mandatory in Rel-16. Additionally, Alt-1 may have problem for the FG where only some components are not applicable (e.g., 15-3). 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 impact to Rel-16 UE implementation. Although it seems none of the alternatives is the perfect solution, Alt-1 seems to be the choice given the cons and pros.*Proposal 4:* *Rel-17 SL UE is not mandated to support all Rel-16 SL basic FGs.* |
| [6] | CATT, GOHIGH | For Rel-16, some UE features are defined as basic UE feature group for NR sidelink. If a UE support Rel-16 NR sidelink, the UE should indicate the support of these features as they are mandatory. However, many of the Rel-17 are for UEs that do not implement all of the Release-16 basic features. For example, Rel-16 full sensing or PSCCH/PSSCH reception will not be supported by Rel-17 pedestrian UE. Then the question here is if these Rel-16 basic UE features are still considered as mandatory features for Rel-17 sidelink UE. It seems the answer is no. Therefore, the first issue that needs to be clarified is that Rel-17 SL UE is not mandated to support all Rel-16 SL basic FGs. It is noted that this means Rel-17 SL UE may not be backward compatible with Rel-16 network. It also means that Rel-17 SL UE need to be defined based on different Rel-17 feature groups, and they also need to report Rel-16 capabilities, as Rel-16 features and Rel-17 features are independent.***Proposal 1:*** ***Rel-17 SL UE is not mandated to support all Rel-16 SL basic FGs.******Proposal 2: It need to further study on how to indicate the non-backward compatible between Rel-16 and Rel-17 FGs.*** The two separate FGs on Tx capability has been agreed in RAN1#106b-e meeting, i.e. random selection and partial sensing. From Tx capability perspective, if one UE supports partial sensing, it means it is capable of PSCCH and PSSCH reception. Therefore, if a UE is capable of partial sensing, it is also capable of full sensing. Regarding the combinations of Tx capabilities with different sensing schemes, it can be indicated by the combination of the two separate FGs.***Proposal 2: It is unnecessary introduce FGs on Tx capabilities with more than none sensing schemes, it can be indicated by the combinations of the two agreed separate FGs.***Regarding Rx capability, since there would be some incapable indications of the Rel-16 basic FGs in Rel-17 UE Rx capability, the non-backward compatible issue should be resolved firstly. In RAN1#106b-e meeting, moderator has proposed the FGs on Rx capabilities as follows[3]:

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| --- |
| * + **Rx capabilities**
		- **FFS: whether/how to represent the capability for no SL reception**
		- **FFS: SL reception of PSFCH/S-SSB**
			* **FFS: whether to split the capability into one for PSFCH and the other for S-SSB**
 |

We are fine to introduce two Rx capability types, i.e. no SL reception, and SL reception of PSFCH/S-SSB only. But whether/how to represent these capabilities should be further studied, since all these two reception capabilities is conflict with Rel-16 basic FGs. Regarding whether to further split the reception capability on PSFCH/S-SSB reception, it is preferred that no further splitting is necessary at current stage. ***Proposal 3: For Rx capabilities used as FGs for Rel-17 sidelink:**** ***FFS: whether/how to represent the capability for no SL reception***
* ***FFS: whether/how to represent the capability for SL reception of PSFCH/S-SSB only***
 |
| [7] | OPPO | * TX capability

For the TX capability, it was agreed to support mode 2 with random resource selection and mode 2 with partial sensing as FGs for Rel-17 SL. One remaining FFS is whether to support the capability of mix sensing schemes as additional FG. In our view, it is not necessary. UE will report the FGs including one or more of the following FGs:* mode 2 with random resource selection
* mode 2 with partial sensing
* mode 2 with full sensing

Reporting one or more of above FGs can be used to indicate which TX capabilities are supported by the UE, there is no necessary to additional indicate a mix sensing scheme.**Proposal 1: The FG of combination of more than one sensing schemes is not necessary.**Furthermore, we don’t think the above agree TX capabilities should be basic FG.**Proposal 2: The following FGs are not basic FG for Rel-17 SL enhancement:*** **mode 2 with random resource selection**
* **mode 2 with partial sensing**
* RX capability

The following candidate RX capabilities were discussed in last meeting and no agreement achieved:* Potential Rx capabilities
	+ SL reception Type A
	+ SL reception Type B (FG 32-2)
		1. Whether to split PSFCH and S-SSB receptions
	+ SL reception Type D (FG 32-1)

Firstly, SL reception Type D is already supported in Rel-16. For SL reception Type B, we support it to be a new FG. While we don’t think the necessary to split PSFCH and S-SSB reception. They can be combined into one FG. For SL reception Type A, it can also be a new FG. The components for Type A and Type B FGs should be different with Type D FG. For example, there is no sensing behavior, no re-evaluation checking, no pre-emption checking for Type A and Type B FGs. The FGs for SL reception Type A and Type B should not be basic FGs of Rel-17 SL enhancement.**Proposal 3: Following Rx capabilities are used as FGs for Rel-17 SL*** **SL reception Type A**
* **SL reception Type B**

**Proposal 4: The above Rx capabilities are not basic FG for Rel-17 SL enhancement.*** The relationship between Rel-17 FGs and Rel-16 basic FGs for NR SL

Considering new types of UE are introduced in Rel-17, such as Type A UE which has no reception capability and Type B UE which can only receive S-SSB and PSFCH, not all of Rel-16 basic FGs will be supported in Rel-17. It is possible that Rel-17 UE only implement partial basic FGs defined in Rel-16. **Proposal 5: Rel-17 SL UE is not mandated to support all Rel-16 SL basic FGs*** **FFS which Rel-16 SL basic FGs should are not mandated to be supported by Rel-17 SL UE**
 |
| [8] | Intel Corporation | The major sidelink features developed or being developed in R17 are:* Power saving resource allocation schemes
	+ Sidelink mode-2 transmission based on random resource selection
	+ Sidelink mode-2 transmission based on partial sensing
* Inter-UE coordination solutions
	+ Inter-UE coordination for sidelink conflict avoidance (i.e., inter-UE coordination scheme #1)
	+ Inter-UE coordination for sidelink conflict resolution (i.e., inter-UE coordination scheme #2)

These work directions can be considered as a major FGs for R17 discussion on UE feature list. Considering the latest status of RAN1 discussion we do not see strong motivation to support the following FGs:* 32-1 [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB]
	+ Reason: This is not a new R17 feature but rather a baseline functionality of R16
* 32-2 [Receiving NR sidelink of PSFCH/S-SSB only]
	+ Reason: In our view this can be a component of the new FG (i.e., NR sidelink mode-2 with random resource selection)
* 32-3 [Transmitting NR sidelink mode 2 with full sensing]
	+ Reason: This is not a new R17 feature but rather a baseline functionality of R16

In our view, at least the following FGs can be introduced for R17 enhancements:* Sidelink mode-2 transmission based random resource selection
* Sidelink mode-2 transmission based on partial sensing
* Inter-UE coordination scheme 1 for sidelink conflict avoidance
* Inter-UE coordination scheme 2 for sidelink conflict resolution

We are also supportive of the further split for inter-UE coordination schemes with a motivation to split functionality required for generation/transmission of inter-UE coordination feedback from functionality of reception and application of inter-UE coordination feedback. From that perspective the following FGs can be also considered:* FG 32-x3-A: Generation and transmission of inter-UE coordination feedback for scheme 1
* FG 32-x3-B: Reception and application of inter-UE coordination feedback for scheme 1
* FG 32-x4-A: Generation and transmission of inter-UE coordination feedback for scheme 2
* FG 32-x4-B: Reception and application of inter-UE coordination feedback for scheme 2
	+ **Support at least the following FGs for R17 NR sidelink enhancements:**
		- **32-x1: Sidelink mode-2 transmission based on random resource selection**
		- **32-x2: Sidelink mode-2 transmission based on partial sensing**
		- **32-x3: Inter-UE coordination scheme 1 for NR sidelink mode 2**
		- **32-x4: Inter-UE coordination scheme 2 for NR sidelink mode 2**
	+ **Further discuss additional split of FGs for inter-UE coordination schemes**

Our initial views on components for sidelink FGs are provided in Table 2.Table 2: Feature groups for NR sidelink enhancements and their components

|  |  |  |
| --- | --- | --- |
| **32-x1** | Sidelink mode-2 transmission based on random resource selection | 1) UE can receive PSFCH/S-SSB only2) UE can transmit PSCCH/PSSCH using NR sidelink mode-2 with random resource selection |
| **32-x2** | Sidelink mode-2 transmission based on partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode-2 with partial sensing (periodic and contiguous) |
| **32-x3** | Inter-UE coordination scheme 1 for sidelink conflict avoidance | 1) UE can transmit request for scheme 1 inter-UE coordination feedback2) UE can generate and transmit request-based inter-UE coordination feedback for preferred and non-preferred resource sets3) UE can generate and transmit condition-based inter-UE coordination feedback for preferred and non-preferred resource sets4) UE can receive and apply request-based inter-UE coordination feedback for mode-2 sidelink transmission5) UE can receive and apply condition-based inter-UE coordination feedback for mode-2 sidelink transmission |
| **32-x4** | Inter-UE coordination scheme 2 for sidelink conflict resolution | 1) UE can transmit request for scheme 2 inter-UE coordination feedback2) UE can generate and transmit scheme 2 inter-UE coordination feedback3) UE can receive and apply scheme 2 inter-UE coordination feedback for mode-2 sidelink transmission |

* + **Use sidelink FGs and associated FG components provided in Table-2 as a starting point for further discussion on UE features for R17 enhancements**

|  |
| --- |
| * 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)
 |

The above aspect deserves a bit more discussion. In our view, if the intention is to create separate FG for UEs that do not support sidelink reception and only support sidelink transmission, then additional FG can be considered and are motivated. Otherwise, we do not see strong motivation to introduce new FGs for sidelink reception.

|  |
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| * Discuss the relationship between the FGs 32-1 to 32-4 and Rel-16 basic FGs for NR SL
 |

In our view, some of the FGs introduced on Rel.17 should have as a pre-requisite Rel.16 FGs. For instance, it seems that at least FGs associated with inter-UE coordination should support basic FGs of Rel.16 unless those are further sub-divided. At the same time FGs associated with power saving sidelink resource allocation schemes seem do not need to support all Rel16 FGs. This aspect can be discussed further when the list of R17 FGs for sidelink stabilizes.

|  |
| --- |
| * Discuss whether FGs 32-1 to 32-4 should be supported as basic FGs for Rel-17 SL enhancement
 |

New FGs 32-x1 to 32-x4 were proposed in this contribution, but we still do not see strong motivation to define any of them as a basic FG for Rel.17. |
| [9] | Xiaomi | *On UE sidelink Rx 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

FG 32-1 is the same as Rel-16 sidelink receiving capability, and thus it can be removed from Rel-17 sidelink FGs. In addition, other than FG 32-2 where UE can receiver NR PSFCH/S-SSB only, a UE receiving capability should be defined to support UEs without sidelink receiving capacity but only with sidelink transmitting capability. **Proposal 1: A UE feature group should be defined to support UEs not capable of performing reception of any SL signals and channels.***On UE transmitting capability*In [1] mode 2 with full sensing as defined as FG 32-3, and 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: Mode 2 with full sensing is not defined as the prerequisite of feature group mode 2 with partial sensing.** |
| [10] | 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)
 |

The characteristic of different types of UE is elaborated as follows: 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/S-SSB only. Thus UE can only perform random selection only due to lack of sensing results.Type D: UE can receive all SL signals/channels defined in R16. This UE capability can be indicated using Rel-16 legacy signaling.The motivation for splitting the reception capability for PSFCH/S-SSB is unclear [2]. Moreover, according to Rel-16 UE capability signaling, the *FG15-4 Synchronization sources for NR sidelink* was a basic FG including the reception of S-SSB as one of the components. This makes the signaling flexibility of allowing UE to perform PSFCH reception only questionable.In short, to reflect the above capability, the original 32-1 needs to be removed and be replaced by the signalling for Type A UE as shown in the following modification

|  |  |
| --- | --- |
| Feature group | Components |
| 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
 |

The following is thus proposed to reflect the above1. The following Rx capability should be reflected in the corresponding FGs/components.

|  |  |
| --- | --- |
| Feature group | Components |
| 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
 |

Given the UE capability for Rel-17 is more of optimization essence, 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.1. There is no need to define basic FGs for Rel-17 NR SL
* The note "FFS: For UE supports LTE Uu configuring NR sidelink, UE must indicate this FG is supported." can be removed for all the FGs
 |
| [11] | Samsung | Also, it was agreed in RAN1#106bis-e meeting [3] that a FG of transmitting NR sidelink mode 2 with random selection is supported. 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 [4], 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:*** *Considering random selection and partial sensing are supported as TX capabilities in Rel-17 sidelink, the following combinations of sensing schems are supported as FGs 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*

Further details for proposal 1 were captured in Appendix (See, UE feature index 32-3, 32-4 and 32-5).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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. |

 |
| [12] | Apple | One of the RAN1 objectives in Release 17 NR sidelink enhancement is to specify resource allocation to reduce power consumptions of UEs. Two different sidelink transmission capabilities are defined for Release-17 sidelink: mode 2 with random resource selection and mode 2 with partial sensing. It is open whether sidelink transmission capabilities with more than one sensing schemes are defined. In our view, a UE can have more than one sidelink transmission capability. For example, a UE can support both full sensing and partial sensing. If three different sidelink transmission capabilities are independently defined: full sensing (i.e., feature 15-3 in [3]), partial sensing and random resource selection, then a UE is already able to indicate it supports more than one sidelink transmission capability. Hence, there is no need to define combinatorial sidelink transmission capability.***Proposal 1:*** *Introduce two independent sidelink transmission capabilities: transmitting NR sidelink mode 2 with random resource selection and transmitting NR sidelink mode 2 with partial sensing.* * *No need to define combinatorial sidelink transmission capability.*

The potential sidelink reception capabilities were discussed in RAN1 #106b-e meeting. 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. On the other hand, Type D UE is actually Release-16 UE, whose capability is already defined as feature 15-1 in [3]. Hence, there is no need to re-define the same UE capability. Therefore, only one new UE feature needs to be defined for Type B UE. ***Proposal 2:*** *Introduce a new UE feature of “receiving NR sidelink of PSFCH and S-SSB”.* There are several sidelink basic features defined in Release-16 NR sidelink. These include features 15-1, 15-2 (in licensed spectrum), 15-3, 15-4, 15-5, 15-11, 15-14, 15-23. In Release-17 NR sidelink, it is possible that a UE does not receive any sidelink signals (i.e., Type A UE), but transmits NR sidelink mode 2 with random resource selection. At least for this type of UE, none of the sidelink basic features defined in Release-16 NR sidelink is applicable. Hence, we think Release-17 sidelink UE is not mandated to support any of Release-16 sidelink basic features. ***Proposal 3:*** *Release-17 sidelink UE is not mandated to support any of Release-16 sidelink basic features.*  |
| [13] | NTT DOCOMO, INC. | In Rel-17, any combinations of full sensing / partial sensing / random selection can be supported including support of only a single TX mechanism. At the latest Rel-17 UE feature list, there are two rows. One is for full sensing and the other is for partial sensing.However, we believe that the rows are not aligned with the agreement above. Full sensing is Rel-16 feature, so there would be no need to introduce an FG for full sensing. Instead, one row is necessary for random selection. Not support of full sensing and partial sensing does not mean support of random selection. Dedicated FG for random selection should be added.Regarding details of each FG, we think the current Rel-17 capabilities with Rel-16 capability cannot represent some of combinations of supporting TX mechanism due to Rel-16 capability signalling. In Rel-16, although there is a capability corresponding to full sensing – FG 15-3, FG 15-3 has a lot of other features as MCS/PT-RS/number of symbols/etc. Only component 4 is a text for full sensing. For example, if a Rel-17 UE supports partial sensing only, the UE will indicate support of FG 32-4 and not indicate support of FG 15-3. In this case, support of components 1 to 11 in FG 15-3 becomes unclear, so corresponding components should be included in FG 32-4 as well.In other words, with the update as below, UE supporting full sensing can indicate support of FG 15-3, and UE supporting partial sensing can indicate support of FG 32-4. Same direction can be applied to FG for random selection as well.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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. Up to B sidelink processes are supported.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 PSSCH according to the normal 64QAM MCS table.5) UE supports PT-RS transmission in FR2.6) UE can transmit using the subcarrier spacing and CP length it reports for FG 15-17) 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.8) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR29) DL pathloss based open loop power control when mode 2 is configured by NR Uu | [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. |

**Proposal 1:*** *Remove FG 32-3. Support of full sensing is indicated by FG 15-3.*
* *Introduce new FG for support of random selection.*
* *FG 32-4 and FG for support of random selection include the same components as in FG 15-3 except for component 4).*

In similar way to TX capabilities, we believe that Rel-16 capabilities cover support of RX perspective. FG 15-1 indicates support of PSCCH/PSSCH reception, FG 15-4 includes reception perspective of S-SSB, and FG 15-11 has a text of reception aspect of PSFCH. At least not support of PSCCH/PSSCH reception can be indicated by FG 15-1, so the current FG 32-1 would be unnecessary.Meanwhile, FG 15-4 and FG 15-11 cannot be used to indicate not support of reception perspective since these FGs include other aspects like transmission perspective, GNSS-based synchronization, etc. Therefore, new FGs are necessary to indicate not support of those receptions but support of other behaviours on S-SSB/PSFCH. Regarding FG split between PSFCH reception and S-SSB reception, we are fine with either joint FG or separate FGs. The following FGs are suggestion from our side based on the above analysis. For example, UE supporting PSFCH TX but not supporting PSFCH RX indicates this new FG 32-1 but will not indicate FG 15-11.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-1 | ~~[Receiving~~ ~~NR sidelink of PSCCH/PSSCH~~PSFCH format 0 without reception~~/S-SSB]~~ | ~~1) UE can receive NR PSCCH/PSSCH/PSFCH/S-SSB.~~1) UE can transmit NR PSFCH format 02) UE can transmit up to M PSFCH(s) resources in a slot | 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]~~Synchronization sources for NR sidelink without S-SSB reception | ~~1) UE can receive NR PSFCH/S-SSB only.~~1) UE can transmit S-SSB in NR sidelink if it supports 15-2 or 15-3.2) UE supports GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to false.3) UE additionally supports gNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.4) UE additionally supports gNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | 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. |

**Proposal 2:*** *No new FG is introduced to indicate not support of PSCCH/PSSCH reception. FG 15-1 is used for the purpose.*
* *Update FG 32-1 to indicate support of PSFCH format 0 without reception. UE not supporting PSFCH RX uses this FG instead of FG 15-11.*
* *Update FG 32-2 to indicate support of sync. without S-SSB reception. UE not supporting S-SSB RX uses this FG instead of FG 15-4.*

In Rel-16 SL, there are multiple basic FGs – FGs 15-1/15-2/15-3/15-4/15-5/15-11/15-14/15-23. At the last meeting, there were discussions on whether Rel-17 UE shall support these FGs or not. In our view, power saving UE can skip support of some these FGs. However, UE supporting full sensing and inter-UE coordination should support of them since such a UE is UE enhanced beyond Rel-16. There is no motivation to drop these FGs for the UE.In addition, we believe that further discussions are necessary for clarification on whether UE not supporting Rel-16 basic FGs can use a resource pool with the corresponding feature. For example, let us assume a resource pool (pre-)configured with full sensing, partial sensing, and congestion control. Rel-16 UE will use full sensing and congestion control of course. Also Rel-17 UE supporting full sensing will perform congestion control. Then Rel-17 UE supporting partial sensing but not supporting congestion control can use the resource pool? This aspect is unclear currently, so we suggest to discuss this as well.**Proposal 3:*** *Rel-17 UE that does not support full sensing is allowed not to support some of Rel-16 basic FGs.*
	+ *Discuss which FG*
* *Rel-17 UE that supports full sensing shall support all Rel-16 basic FGs.*
* *Discuss whether UE that does not support some Rel-16 basic FGs (e.g. 15-5 (congestion control)) is allowed to use a resource pool (pre-)configured with corresponding parameters.*
 |
| [14] | Qualcomm Incorporated | 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. Another example is sensing and partial sensing, which both require baseband processing taking away processing resources from other operators. 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 not basic features and are not required of a UE that supports NR sidelink.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.A new FG corresponding to the random selection capability in the following agreement from RAN1 #106bis-e is introduced:**Agreement**Following Tx capabilities are used as FGs for Rel-17 SL* mode 2 with random resource selection
* mode 2 with partial sensing
* FFS: TX capabilities with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection})

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling.  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 32. NR\_SL\_enh | 32-4a | 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. |  | [Yes] | [Yes] | The UE does not support transmission using random selection | [Per FS] | N.A. | N.A. | N.A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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] | The UE does not support trasmissoin according to the partial sensing and resource allocation | [Per FS] | N.A. | N.A. | N.A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling.  |

 |
| [15] | MediaTek Inc. | In the last RAN1-106bis-e meeting, the FGs related to random resource selection and partial sensing are agreed to be used as TX capabilities. There were discussions whether multiple sensing schemes (i.e., any combination of full sensing, partial sensing, and/or random resource selection) should be bundled as a separate UE capability. Hence an FFS point was noted on such TX capability. Each of these sensing schemes are intended to provide UE with a level of power saving gain at the expense of decreased reliability Each sensing scheme can essentially be applied in a different use case. If UE intends to support a different use case tailored for a different power saving or reliability target, the UE can indicate capability for more than one of these sensing schemes. However, the benefit of supporting a single capability that indicates a set of different sensing schemes is not clear. Each sensing scheme in Rel-17 is designed essentially to be self-sufficient without any additional pre-requisite of supporting another sensing scheme. With these views, we propose the following.**Proposal 1: Do not support any TX capabilities as bundled with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection}) as FGs for Rel-17 SL.** During the email discussions in the last RAN1-106bis-e meeting, the following proposal was raised for RX capabilities as FGs for Rel-17 SL.* + **Rx capabilities**
		- **FFS: whether/how to represent the capability for no SL reception**
		- **FFS: SL reception of PSFCH/S-SSB**
			* **FFS: whether to split the capability into one for PSFCH and the other for S-SSB**

In our view, no SL reception capability should be represented in Rel-17 as some UE can still support sidelink transmission without reception capability in some scenarios (e.g., P2V pedestrian safety). One approach to realize “no SL reception” capability is by including reception of different channel cases under different FGs. For example, reception of PSFCH, reception of S-SSB, and reception of all SL PHY channels can each be defined as separate FG with optional UE support. If a UE indicates “no support” for all of the aforementioned FGs related to SL reception, the UE can be deduced to have “no SL reception” capability. Another approach is to define a dedicated FG to indicate “no SL reception” case. However, such definition would basically make a FG associated with a “no capability” case, which may not be the most sensible approach. For that reason, the first approach should be adopted. We propose the following.**Proposal 2: RX capability for each SL PHY channel should be included in one of the available FGs (e.g., one FG for reception of all SL PHY channels, another FG for reception of PSFCH, another FG for reception of S-SSB, etc.) as optional, in which case a UE indicating “no support” for all of the aforementioned FGs is understood to have no SL reception capability.** Another discussion point was about whether PSFCH and S-SSB reception capabilities should be split into separate FGs. We are supportive of such split as these PHY channels essentially have different functionalities in possibly different user scenarios. A UE may prefer to have RX capability for PSFCH in a performance-sensitive SL use case wherein reliable packet transmissions are essential while reception of S-SSB is not necessary (e.g., in sidelink use cases for in-coverage scenario). Or, support for S-SSB reception may be an important necessity for UE if the coverage conditions are varying, although high system reliability may not be required. For these reasons, it is essential to split the reception of PSFCH and S-SSB. We propose the following. **Proposal 3: SL reception capability of PSFCH/S-SSB shall be split into two capabilities for PSFCH and for S-SSB.** According to the list 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** | **Does UE support?**  | **Does UE support?** | **Does UE support?** |
| 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 |
|  |  | Type-D UE | Type-B UE | Type-A UE |

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 4: Feature groups 32-1 and 32-2 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 resource reservation types. 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. However, a UE that performs partial sensing should not be required to support full sensing as capability. Therefore, the prerequisite feature groups for 32-4 should not include FG 32-3. We propose the following.**Proposal 5: FG 34-3 should not be a prerequisite for FG 32-4. In other words, UE performing partial sensing should not be required to support full sensing in Rel-17.**As defined in [1], feature index 32-3 and 32-4 describe full sensing and partial sensing features as optional. As indicated in 32-4 [1], 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 32-3 and 32-4 regarding UE sensing operation for SL power-saving. **Proposal 6: Feature groups 32-3 and 32-4 are supported as indicated in Table III above.** |
| [16] | Ericsson | The feature group 32-1 above indicates that a UE is capable of receiving all the SL PHY signalling, i.e., PSCCH, PSSCH, PSFCH and S-SSB, which is the same capability as defined in Rel-16 UE features. In our view, since a FG has already been introduced in Rel-16 UE features which covers the same functionality as the one in FG 32-1, there is no need to define a new FG in Rel-17. Therefore, we propose to remove this FG and re-use the one that was defined in NR SL Rel-16 for FG 15-1, i.e., Receiving NR sidelink.1. Remove the FG 32-1 since it is possible to reuse the FG (15-1) introduced in Rel-16 UE features for UEs receiving all SL PHY signalling.

The feature group 32-2 indicates that a UE has a reduced SL reception capability, i.e., the UE is able to receive the PSFCH and S-SSB. We are supportive of including this FG since it is a new capability agreed in Rel-17 and it is aligned with the agreements and conclusions taken in RAN1. Regarding the wording, we propose to delete the word “only” from the feature group name and components, since it describes more an incapability that an actual UE feature.1. Support the inclusion of FG 32-2 including its components removing the word “only” in the feature group and components.

Nevertheless, this FG should not be defined as a basic FG and therefore, we propose to modify the mandatory/optional field to delete the FFS and keep the text “Optional with capability signalling”.1. FG 32-2 is not a basic FG for Rel-17 SL UE features. It is defined as “Optional with capability signalling”.

In the last RAN1#106bis-e meeting, the following agreement was reached with regards to the inclusion of FGs related to the SL UE Tx capabilities newly defined in Rel-17 for power saving UEs:

|  |
| --- |
| **Agreement*** Following Tx capabilities are used as FGs for Rel-17 SL
	+ - mode 2 with random resource selection
		- mode 2 with partial sensing
		- FFS: TX capabilities with more than one sensing schemes (e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection})
 |

First of all, we would like to point out that having a FG indicating more than one sensing scheme for Tx capabilities simultaneously, e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection}, is not needed. A Rel-17 SL UE can simply signal several supported FGs at the same time.1. Do not consider the addition of FGs indicating Tx capabilities for more than one sensing scheme simultaneously, e.g., {full sensing, partial sensing, random selection}, {partial sensing, random selection}).

Regarding the rest of the Tx capabilities indicated in the agreement reached above, we propose to add, following the agreement, a FG to indicate the operation of a SL UE transmitting using random resource selection:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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-X | 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. |  | [Yes] | [No] | [UE cannot perform random resource selection] | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |

1. Include the above FG 32-X for indicating the capability of UEs performing random resource selection for SL transmission.

The feature group 32-3 indicates the full sensing operation that a UE performs similar to NR SL Rel-16 procedure. Therefore, by using a similar reasoning as for our proposal in Section 2.2, we propose to remove this FG 32-3 and reuse the one specified in Rel-16 UE features in FG 15-3, i.e., Transmitting NR sidelink mode 2.1. Remove the FG 32-3 since it is possible to reuse the FG (15-3) introduced in Rel-16 UE features for UEs transmitting using full-sensing.

The feature group 32-4 indicates that a UE is capable of performing partial sensing operation as defined in RAN1 agreements and also aligned with the agreement reached during the discussion in RAN1#106bis-e regarding UE features (included in Section 2.4). Therefore, we are supportive of including a FG to indicate this capability. 1. Support the inclusion of FG 32-4.

Regarding the detailed description, this FG should not be considered as a basic FG, so we propose to modify the text in the mandatory/optional field to delete the FFS.1. FG 32-4 is not a basic FG for Rel-17 SL UE features. It is defined as “Optional with capability signalling”.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ~~32-1~~Replaced by 15-1 from Rel-16 | ~~[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.~~ |
| 32-2 | ~~[~~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-X | 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.2) UE supports the re-selection and re-evaluation/pre-emption of resources operation |  | [Yes] | [No] | [UE cannot perfom random resource selection] | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |
| ~~32-3~~Replaced by 15-3 from Rel-16 | ~~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.~~ |
| 32-4 | 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.4) UE supports the re-selection and re-evaluation/pre-emption operation. | [32-1], [32-3] | [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.~~ |

 |

## **Discussion**

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

* **Rel-16 basic FGs are not basic FGs for UE supporting Rel-17 SL FGs.**
	+ **Necessary Rel-16 FGs are handled via pre-requisites of Rel-17 FGs**
		- *Support: Huawei, HiSilicon, FUTUREWEI, vivo, CATT, GOHIGH, [OPPO], Apple, [DOCOMO]*

|  |  |
| --- | --- |
| Company | Comment |
| vivo | We are supportive to this proposal, just one question: do we have to send a LS to RAN2 for confirmation (e.g., feasibility, compatibility, etc.)? Noted that for each Rel-16 basic FG, it is specified in 38.306 that: “Support of this feature is mandatory if UE supports NR sidelink”. Thus, it seems some spec changes are required in Rel-17 for these Rel-16 FGs. |
| Qualcomm | We agree with the proposal. |
| Apple  | Support the proposal. |
| OPPO | Support the proposal.  |
| NTT DOCOMO | For power saving UE, we are fine with this. But for IUC UE, normal UE like Rel-16 UE and power saving UE can support IUC. When IUC is implemented on top of Rel-16 UE, for the UEs, basic FGs should be kept. To achieve this, for example a text is needed somewhere as “when Rel-17 UE supports FG 15-1/15-3 (and/or 15-2?), the UE must support other Rel-16 basic FGs”. |
| Xiaomi | We support the proposal. |
| Huawei, HiSilicon | We support this proposal.Rel-17 SL features are designed to allow a Rel-17 UE to not implement all of the Release-16 basic features. As one example, a UE, which is not capable of performing reception of any SL signals and channels, does not need to implement Rel-16 FG 15-1 and other FGs taking FG15-1 as pre-requisites. Pre-requisites are a suitable and sufficient way to handle these cases. One example, for inter-UE coordination operation needs to support Rel-16 FG 15-1, i.e. take Rel-16 FG 15-1 as pre-requisite FG for inter-UE coordination FG.We also note that Rel-17 is not ‘born with’ any basic FGs. If RAN1 does not agree this proposal, the situation is anyway case-by-case, starting from no legacy basic FGs. |

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

* **For Rel-17 SL Tx capabilities,**
	+ **Remove FG 32-3 from Rel-17 UE feature list**
		- **Note: support of transmitting NR sidelink mode 2 with full sensing is reported by FG 15-3 (Transmitting NR sidelink mode 2)**
			* *Support: Huawei, HiSilicon, FUTUREWEI, Intel, Apple, DOCOMO, Qualcomm, Ericsson*
	+ **FG 32-4 is kept as “Transmitting NR sidelink mode 2 with partial sensing” as follows**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.FFS whether any other components should be added | [TBD] | [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. |

Note that any contents highlighted in yellow mean FFS and to be discussed further.

* + **Add an FG for “Transmitting NR sidelink mode 2 with random resource selection” as follows**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 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.FFS whether any other components should be added | [TBD] | [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. |

Note that any contents highlighted in yellow mean FFS and to be discussed further.

* + **TX capabilities with more than one sensing schemes are not introduced to Rel-17 SL UE features**
		- *Support: Huawei, HiSilicon, CATT, GOHIGH, OPPO, Apple, MediaTek, Ericsson*

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Considering 3-1 and 3-2 together, a UE supporting partial sensing would report support of 32-4 but not 15-3. But note that 15-3 defines lots of UE capabilities other than sensing: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 UuSuch information should still be reported by UE without full sensing. Thus, we may have to define another FG in Rel-17 to carrier the above information.  |
| Qualcomm | We agree with the proposal |
| Apple | We support the proposal. |
| OPPO | We support the proposal.  |
| NTT DOCOMO | Support. Regarding vivo’s comment, we have similar view and FFS covers the aspect. We can add more components in 32-4/32-4a as 15-3. |
| xiaomi | We agree with the proposal |
| Huawei, HiSilicon | We support this proposal, but note that the existence of the FG for random selection is agreed already. This is a first attempt at defining the content. 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.RAN1#106bis-e made agreements to define “mode 2 with random resource selection” and “mode 2 with partial sensing” FGs for Rel-17 SL, it is reasonable to define 32-4 and 32-4a.Since the Rel-16 and new Rel-17 RA schemes have been designed to work independently of one another, i.e. there is no need for a UE to support a particular pair of them, the capability signaling can simply allow the UE to indicate each RA scheme separately. Otherwise, a UE may be forced to implement a feature it does not wish to use, only in order to provide the one of interest, e.g. there is no reason to demand random selection be supported when the UE manufacturer is only interested in partial sensing. |

**[FL1] High priority proposal 3-3:**

* **For Rel-17 SL Rx capabilities,**
	+ **Remove FG 32-1 from Rel-17 UE feature list**
		- **Note: support of receiving NR sidelink of PSCCH/PSSCH/PSFCH/S-SSB is reported by FG 15-1 (Receiving NR sidelink)**
			* *Support: Huawei, HiSilicon, FUTUREWEI, DOCOMO, Ericsson*
	+ **FG 32-2 is kept as “Receiving NR sidelink of PSFCH/S-SSB” as follows**

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| 32. NR\_SL\_enh | 32-2 | ~~[~~Receiving NR sidelink of PSFCH/S-SSB ~~only]~~ | 1) UE can receive NR PSFCH/S-SSB ~~only~~.FFS whether to split the capabilities for PSFCH and S-SSB receptions as different FGs | 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. |

Note that any contents highlighted in yellow mean FFS and to be discussed further.

* + **FFS whether/how to report the capability of “no NR sidelink reception”**
		- * *Necessary: vivo, OPPO, Xiaomi, ZTE, Sanechips*
			* *Not necessary: Huawei, HiSilicon, Apple, DOCOMO, MediaTek*
			* *FFS: CATT, GOHIGH*

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| --- | --- |
| Company | Comment |
| vivo | If, combining FL proposal 3-1, this proposal means that a UE can indicate “no NR sidelink reception” by NOT reporting FG 15-1, we are fine with this proposal. In this case the FFS part can be removed. But then it seems that FL proposal 3-1 should be agreed before discussing this proposal. |
| Qualcomm | We prefer to start with separate FGs for PSFCH and S-SSB. The ability, requirements, and benefits of receiving one are independent from the other and there is no need to combine. |
| Apple | We support the proposal. |
| OPPO | We support the proposal.  |
| NTT DOCOMO | We have one question. If FG32-2 is agreed, then we have three related FGs. FG15-4 includes TX and RX perspective. FG15-11 includes TX and RX perspective. FG32-2 includes only RX perspective. These mean that when UE does not support RX perspective, TX is also not supported automatically, i.e. UE supporting only TX perspective is precluded. Is this OK? If companies are OK with this direction, then we are fine with it. At least clarification is necessary. |
| Xiaomi | We are fine with the proposal. |
| Huawei, HiSilicon | We support this proposal.This is used to refer to the Rx operation for which a UE does not perform sensing but synchronization and HARQ-based feedback, given that sensing is a major component of power consumption in Rel-16 mode 2 operation. At least from power reduction point view, it is not necessary to further split PSFCH and S-SSB.On the FFS, we should not introduce an ‘incapability’, as per RAN2 guidance. The FFS should be considered closed on that basis. |

**[FL1] High priority proposal 3-4:**

* **FGs 32-x for receiving NR sidelink and transmitting NR sidelink mode 2 are not basic FGs for Rel-17 sidelink enhancement**
	+ *Support: Intel, ZTE, Sanechips, Qualcomm, MediaTek, Ericsson*

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| --- | --- |
| Company | Comment |
| vivo | We are generally fine with the principle. But given that we have not yet agree with any of the 32-x FG, isn’t it too early to decide whether an unknown FG is basic or not? Or maybe we can have it as a working assumption and then check the Rel-17 FG one by one. |
| Qualcomm | We support the proposal. |
| Apple | We are generally fine with the proposal.  |
| OPPO | We support the proposal. |
| NTT DOCOMO | Support. |
| Xiaomi | We are fine with the proposal. |
| Huawei, HiSilicon | We support this proposal, but similar does not need to be decided in the negative logic for every FG. Proponents of making an FG basic need to bring that positive-logic proposal and have it agreed, and otherwise an FG is by default not basic.For the UE with only the capability of random selection, it has no need to implement FGs 32-x for the receiving NR sidelink and transmitting NR sidelink mode 2. |

**Medium priority question 3-5:**

* **Companies are encouraged to provide views on whether UE that does not support some Rel-16 basic FGs (e.g. 15-5 (congestion control)) is allowed to use a resource pool (pre-)configured with corresponding parameter**

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| Company | Comment |
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**Medium priority question 3-6:**

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

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| Company | Comment |
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**Medium priority question 3-7:**

* **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”**
	+ *Yes: Huawei, HiSilicon, MediaTek*

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| Company | Comment |
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**Medium priority question 3-8:**

* **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”**
	+ *No: MediaTek*

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| Company | Comment |
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**Low priority question 3-9**

* **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 |
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**Low priority question 3-10**

* **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.  |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| [3] | Huawei, HiSilicon | There are two inter-UE coordination schemes, where scheme 1 allows 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 options 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 4: Define inter-UE coordination scheme 1 and scheme 2 as separate UE features, FG 32-5 (scheme 1) and FG 32-6 (scheme 2).***See below for an overall entry for this new FG 32-6.In the last RAN1#106b-e meeting, RAN1 has achieved the following agreements for inter-UE coordination scheme 2.***Agreement****For Scheme 2, PSFCH format 0 is used to convey the presence of expected/potential resource conflict on reserved resource(s) indicated by UE-B’s SCI****Agreement**** *For allocating PSFCH resources in Scheme 2, at least following can be (pre)configured separately from those for SL HARQ-ACK feedback.*
	+ *Set of PRBs for PSFCH transmission/reception (sl-PSFCH-RB-Set)*

For PSFCH format 0 to transmitting sidelink HARQ, the UE feature 15-11 has been defined, where the following component to support the PSFCH format 0 transmission and reception.

|  |  |  |  |
| --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Note** |
| 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 | This is the basic FG for sidelink.Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1Candidate values for N are {5, 15, 25, 32, 35, 45, 50, 64}Candidate values for M are {4, 8, 16} |

We think similar feature group of PSFCH format 0 used to convey the presence of expected/potential resource conflict on reserved resource(s) in inter-UE coordination scheme 2 in NR sidelink mode 2 should be defined to treat the supported transmission and reception capability of PSFCH format 0. For the value (N1, M1) of reception/transmission PSFCH(s) resources for coordination indication, one simple way is to reuse the candidate values set for M and N in Rel-16, since the same PSFCH format 0 is used. And we also noted that there would be cases where the transmission/reception between PSFCH format 0 for inter-UE coordination in NR sidelink and PSFCH format 0 for sidelink HARQ feedback may happen in the same PSFCH resource slots. Since Rel-17 UE hardware can reuse Rel-16’s, the capacity of reception/transmission of total PSFCH(s) resources may limit by Rel-16 values. UE is expected to manage its capability report between Rel-16 FG 15-11 values and related Rel-17 values.For example, if UE reports N = 64 in Rel-16 only case, it may report N = 32 and N1 = 32 in Rel-17 to make sure the total PSFCH(s) resources is 64.In order to align with current candidate values for N of {5, 15, 25, 32, 35, 45, 50, 64}, new value {10} need to be added in Rel-17 to achieve the combination of 10 and 5 in the candidate values set {5, 15, 25, 32, 35, 45, 50, 64}. For example, this allows a UE which would report N = 35 in Rel-16 to report {N, N1} = {25, 10}.Similarly, a new value of {12} need to be added to candidate values for M for the same purpose.***Proposal 5: Capability of PSFCH format 0 transmission/reception for scheme 2 is a component of the scheme 2 FG:**** ***1) UE can transmit and receive NR PSFCH format 0 which conveys the presence of expected/potential resource conflict***
* ***2) UE can receive up to N1 PSFCH(s) resources in a slot which convey the presence of expected/potential resource conflict***
	+ ***The candidate value for N1 are {5, [10], 15, 25, 32, 35, 45, 50, 64}***
* ***3) UE can transmit up to M1 PSFCH(s) resources in a slot which convey the presence of expected/potential resource conflict***
	+ ***The candidate value for M1 are {4, 8, [12], 16}***
* ***UE is expected to manage its capability report between FG 15-11 values and FG 32-6 values***

The changes of UE feature list for NR\_SL\_enh are listed as following

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** |
| 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]. | [32-1] |  |
| 32-6 | Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1) UE can transmit and receive NR PSFCH format 0 which conveys the 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 receive up to N1 PSFCH(s) resources in a slot which convey the presence of expected/potential resource conflict3) UE can transmit up to M1 PSFCH(s) resources in a slot which convey the presence of expected/potential resource conflict | 15-1, 15-11 | The candidate values for N1 are {5, [10], 15, 25, 32, 35, 45, 50, 64}The candidate values for M1 are {4, 8, [12], 16}UE is expected to manage its capability report between FG 15-11 values and FG 32-6 values |

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 7: UE features regarding resource allocation schemes and inter-UE coordination schemes need to be informed to gNB*** |
| [4] | FUTUREWEI | Further, as in Appendix, a working assumption is reached where capabilities of inter-UE coordination schemes 1 and 2 in NR sidelink mode 2 were included in a working assumption but not as the basic FGs for Rel-17 sidelink. The agreement and the working assumption are aligned with our proposal in [6]. The remaining point of difficulty is how to handle the prerequisites. The prerequisite FGs or FG components to support the potential new FGs in Rel-17 were discussed in RAN1#106bis-e. It is a common view that it is not necessary to support all Rel-16 SL basic FG’s for these Rel-17 SL features. However, the proposal was not agreed as companies were not in consensus on whether to identify which Rel-16 SL basic FGs are not mandated to be supported by Rel-17 SL UE, i.e., the direction of “deleting down”, or to identify which Rel-16 SL basic FGs should be supported by Rel-17 SL UE, i.e., the direction of “building up”. However, from our perspective, whether "deleting down" or "building up" is not so critical, the important thing is that any necessary Rel-16 FGs or FG components should be clearly indicated in the Rel-17 FG pre-requisite column to avoid redefining the same FGs/components that are already in Rel-16.***Proposal 1: Any necessary Rel-16 FGs/components will be indicated in the Rel-17 FG pre-requisite column to avoid redefining the same FGs/components already in Rel-16.***Following the discussions above and as in our last proposal, if the Type A/B/D UEs, i.e., FGs under Rx capabilities, are not included as new features, the prerequisite FG for the agreed FGs and the ones for inter-UE coordination in the WA is UE FG 15-3 in Rel-16. Therefore, we have the following proposal.***Proposal 2: Specify UE FG 15-3 as the prerequisite FG of the following agreed new FGs or the FGs in the working assumption for Rel-17 sidelink enhancement:**** ***mode 2 with random resource selection***
* ***mode 2 with partial sensing***
* ***inter-UE coordination schemes 1 and 2***
 |
| [5] | 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 schemes, considering that these schemes are targeting different scenarios. More specifically, three FGs should be defined for inter-UE coordination respectively, such as scheme 1 with preferred resource set, scheme 1 with non-preferred resource set, and scheme 2.*Proposal 5:* *Separate UE features are defined for different inter-UE coordination schemes, including* *scheme 1 with preferred resource set, scheme 1 with non-preferred resource set, and scheme 2, respectively.* |
| [6] | CATT, GOHIGH | 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. Regarding whether further splitting the inter-UE coordination scheme 1, it depends on further progress on the discussion of inter-UE coordination. ***Proposal 4: FGs on inter-UE coordination for mode 2 enhancements can be split to two FGs:**** ***Inter-UE coordination scheme 1 in NR sidelink mode 2***
	+ ***FFS whether/how to split into multiple FGs***
* ***Inter-UE coordination scheme 2 in NR sidelink mode 2***
 |
| [7] | OPPO | For inter-UE coordination, we suggest to split the capability into following FGs:

|  |  |  |  |
| --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-5a | Determine and transmit Inter-UE coordination in NR sidelink mode 2 | 1) UE can receive an explicit request and transmit inter-UE coordination information of preferred resource set/non-preferred resource set. 2) UE can transmit inter-UE coordination information of presence of expected/potential resource conflict. |

|  |  |  |  |
| --- | --- | --- | --- |
| 32. NR\_SL\_enh | 32-5b | Receive and use Inter-UE coordination in NR sidelink mode 2 | 1) UE can transmit an explicit request 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 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. |

FG 32-1(Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB) and 35-3(Transmitting NR sidelink mode 2 with full sensing) should be prerequisites of this FG 32-5a, as only a UE having full sensing capability can receive the explicit request and determine inter-UE coordination information accordingly. The prerequisites of FG 32-5b should be 32-1(Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB) and at least one of 32-3(Transmitting NR sidelink mode 2 with full sensing) or 32-4(Transmitting NR sidelink mode 2 with partial sensing).**Proposal 6: FG 32-5 is split into 2 FGs 32-5a and 32-5b.*** **FG 32-5a: FG 32-1 and 35-3 should be prerequisites of this FG 32-5a**
* **FG 32-5b: FG 32-1 and at least one of 32-3 or 32-4 should be prerequisites of this FG 32-5a**

We did not see the need to split 32-5a or 32-5b above per Scheme 1 or Scheme 2. For 32-5a, if a UE support full sensing, it should be able to determine and transmit inter-UE coordination information for both Scheme 1 and Scheme 2. And for 32-5b, there is no much difference for UE to use inter-UE coordination information in Scheme 1 or Scheme 2 during resource (re-)selection.**Proposal 7: It is not necessary to further split FG 32-5a and 32-5b for Scheme 1 and Scheme 2 respectively.**The FG 32-5 should be per-UE. There is no need for the gNB to know the functionality as it is mode 2. And the capability should be exchanged between UE-A and UE-B such that they could inter-work accordingly. |
| [8] | Intel Corporation | The major sidelink features developed or being developed in R17 are:* Power saving resource allocation schemes
	+ Sidelink mode-2 transmission based on random resource selection
	+ Sidelink mode-2 transmission based on partial sensing
* Inter-UE coordination solutions
	+ Inter-UE coordination for sidelink conflict avoidance (i.e., inter-UE coordination scheme #1)
	+ Inter-UE coordination for sidelink conflict resolution (i.e., inter-UE coordination scheme #2)

These work directions can be considered as a major FGs for R17 discussion on UE feature list. Considering the latest status of RAN1 discussion we do not see strong motivation to support the following FGs:* 32-1 [Receiving NR sidelink of PSCCH/PSSCHPSFCH/S-SSB]
	+ Reason: This is not a new R17 feature but rather a baseline functionality of R16
* 32-2 [Receiving NR sidelink of PSFCH/S-SSB only]
	+ Reason: In our view this can be a component of the new FG (i.e., NR sidelink mode-2 with random resource selection)
* 32-3 [Transmitting NR sidelink mode 2 with full sensing]
	+ Reason: This is not a new R17 feature but rather a baseline functionality of R16

In our view, at least the following FGs can be introduced for R17 enhancements:* Sidelink mode-2 transmission based random resource selection
* Sidelink mode-2 transmission based on partial sensing
* Inter-UE coordination scheme 1 for sidelink conflict avoidance
* Inter-UE coordination scheme 2 for sidelink conflict resolution

We are also supportive of the further split for inter-UE coordination schemes with a motivation to split functionality required for generation/transmission of inter-UE coordination feedback from functionality of reception and application of inter-UE coordination feedback. From that perspective the following FGs can be also considered:* FG 32-x3-A: Generation and transmission of inter-UE coordination feedback for scheme 1
* FG 32-x3-B: Reception and application of inter-UE coordination feedback for scheme 1
* FG 32-x4-A: Generation and transmission of inter-UE coordination feedback for scheme 2
* FG 32-x4-B: Reception and application of inter-UE coordination feedback for scheme 2
	+ **Support at least the following FGs for R17 NR sidelink enhancements:**
		- **32-x1: Sidelink mode-2 transmission based on random resource selection**
		- **32-x2: Sidelink mode-2 transmission based on partial sensing**
		- **32-x3: Inter-UE coordination scheme 1 for NR sidelink mode 2**
		- **32-x4: Inter-UE coordination scheme 2 for NR sidelink mode 2**
	+ **Further discuss additional split of FGs for inter-UE coordination schemes**

Our initial views on components for sidelink FGs are provided in Table 2.Table 2: Feature groups for NR sidelink enhancements and their components

|  |  |  |
| --- | --- | --- |
| **32-x1** | Sidelink mode-2 transmission based on random resource selection | 1) UE can receive PSFCH/S-SSB only2) UE can transmit PSCCH/PSSCH using NR sidelink mode-2 with random resource selection |
| **32-x2** | Sidelink mode-2 transmission based on partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode-2 with partial sensing (periodic and contiguous) |
| **32-x3** | Inter-UE coordination scheme 1 for sidelink conflict avoidance | 1) UE can transmit request for scheme 1 inter-UE coordination feedback2) UE can generate and transmit request-based inter-UE coordination feedback for preferred and non-preferred resource sets3) UE can generate and transmit condition-based inter-UE coordination feedback for preferred and non-preferred resource sets4) UE can receive and apply request-based inter-UE coordination feedback for mode-2 sidelink transmission5) UE can receive and apply condition-based inter-UE coordination feedback for mode-2 sidelink transmission |
| **32-x4** | Inter-UE coordination scheme 2 for sidelink conflict resolution | 1) UE can transmit request for scheme 2 inter-UE coordination feedback2) UE can generate and transmit scheme 2 inter-UE coordination feedback3) UE can receive and apply scheme 2 inter-UE coordination feedback for mode-2 sidelink transmission |

* + **Use sidelink FGs and associated FG components provided in Table-2 as a starting point for further discussion on UE features for R17 enhancements**

|  |
| --- |
| * Discuss whether/how to split FG 32-5
 |

We propose to split FG 32-5 at least into two FGs:* + - 32-x3: Inter-UE coordination scheme 1 for NR sidelink mode 2
		- 32-x4: Inter-UE coordination scheme 2 for NR sidelink mode 2

The reason is that two inter-UE coordination schemes are designed independently. Essentially each of these FGs can be further divided into at least two FGs as described in this contribution and we think it is reasonable to partition functionality on feedback generation/transmission and feedback reception/application.

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| --- |
| * Discuss whether FG 32-5 should be supported as a basic FG for Rel-17 SL enhancement
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We do not see motivation behind this proposal. In our view, inter-UE coordination is an incremental feature that can be supported by Rel.17 UEs and there is no dependency with power saving resource allocation solutions defined in Rel.17. |
| [10] | ZTE, Sanechips | The inter-UE coordination info. under scheme 1 and scheme 2 is conveyed by PSSCH/PSCCH and PSFCH respectively. Moreover, the functionality of either scheme is replaceable to the other. Thus it's recommended that either scheme the capability is scheme specific, i.e. allowing the support of only a single scheme.The following is thus proposed to reflect the above consideration.1. FG 32-5 is split to two FGs as follows
* FG 32-5a: Inter-UE coordination scheme 1 in NR sidelink mode 2
* FG 32-5b: Inter-UE coordination scheme 2 in NR sidelink mode 2

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| 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 | Mandatory/Optional |
| 32-5a | 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 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].FFS whether/how to split FG 32-5a into multiple FGs | [TBD] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 1 in NR sidelink mode 2. | [Per band] | N.A. | N.A. | Optional with capability signalling.  |
| 32-5b | 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.FFS whether/how to split FG 32-5b into multiple FGs | [TBD] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 2 in NR sidelink mode 2. | [Per band] | N.A. | N.A. | Optional with capability signalling.  |

 |
| [11] | Samsung | 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*

Further details for proposal 2 were captured in Appendix (See, UE feature index 32-6, 32-7, and 32-8).

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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  | [32-1], [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. |

 |
| [12] | 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 32-5 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. It is agreed that the inter-UE coordination in scheme 2 is carried in PSFCH due to a small number of information bits. This implies that a UE supporting PSFCH/S-SSB reception only 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 of receiving NR sidelink PSFCH/S-SSB only. This UE applies the received inter-UE coordination in its resource re-selection. 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 the feature of receiving all NR sidelink channels as a prerequisite feature group. Hence, it is preferred to at least split 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:*** *At least split feature 32-5 to* * *transmitting inter-UE coordination scheme 1*
* *receiving inter-UE coordination scheme 1*
* *transmitting inter-UE coordination scheme 2*
* *receiving inter-UE coordination scheme 2*

***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.*  |
| [13] | NTT DOCOMO, INC. |

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| [FL4] High priority proposal 3-1:* FG 32-5 is split to two FGs as follows
	+ FG 32-5a: Inter-UE coordination scheme 1 in NR sidelink mode 2
	+ FG 32-5b: Inter-UE coordination scheme 2 in NR sidelink mode 2

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| 32. NR\_SL\_enh | 32-5a | 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 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].FFS whether/how to split FG 32-5a into multiple FGs | [TBD] | [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 | 32-5b | 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.FFS whether/how to split FG 32-5b into multiple FGs | [TBD] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 2 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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At the last meeting, the above FGs were suggested but there was no consensus. In our view, these FGs are good for the initial step, and each can be split into multiple based on discussion progress of the WI, especially for FG 32-5a. Scheme 1 might be supported with all or only subset of the following, which is still under discussions.* 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

On scheme 2, there is only one mechanism, which is collision indication corresponding to expected/potential resource conflict. The current 32-5b would be straightforward while keeping the FFS is fine for us. The split might be that one is for TX perspective of collision indication and the other is for RX perspective of collision indication.**Proposal 4:*** *Introduce new FG for inter-UE coordination scheme 1.*
	+ *FFS: whether to split this FG into multiple.*
* *Introduce new FG for inter-UE coordination scheme 2.*
	+ *FFS: whether to split this FG into multiple.*
 |
| [14] | Qualcomm Incorporated | 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. Another example is sensing and partial sensing, which both require baseband processing taking away processing resources from other operators. 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 not basic features and are not required of a UE that supports NR sidelink.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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |

 |
| [15] | MediaTek Inc. | For inter-UE coordination, the following changes are preffered considering the different behaviors and support for UE-A and UE-B. Moreover, it is also related to the reception capability in SL power saving session. Thus the explicit request may not be able to be received if the UE can’t receive PSSCH/PSCCH or condition based scheme 1.**Proposal 7: FGs 32-5 are split as following Table IV below.****Table IV. Splitting of FG 32-5 for sidelink UE inter-UE coordination operation.**

|  |  |  |  |
| --- | --- | --- | --- |
| Features | Index | Feature group | Components |
| 32. NR\_SL\_enh | 32-5a | Inter-UE coordination in NR sidelink mode 2 (UE-B w/o transmission of the explicit request for scheme 1) | 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. |
| 32. NR\_SL\_enh | 32-5b | Inter-UE coordination in NR sidelink mode 2 (UE-B w/ transmission of the explicit request for scheme 1) | 1) UE can transmit explicit request.2) 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. |
| 32. NR\_SL\_enh | 32-5c | Inter-UE coordination in NR sidelink mode 2 (UE-A w/o reception of the explicit request) | 1) UE can transmit inter-UE coordination information of preferred resource set/non-preferred resource set  |
| 32. NR\_SL\_enh | 32-5d | Inter-UE coordination in NR sidelink mode 2 (UE-A w/ reception of the explicit request) | 1) UE can receive explicit request2) UE can transmit inter-UE coordination information of preferred resource set/non-preferred resource set.  |
| 32. NR\_SL\_enh | 32-6a | Inter-UE coordination in NR sidelink mode 2(UE-A w/ transmission of PSFCH-based indication) | 1) UE can transmit PSFCH-like based indication for scheme 2 in NR sidelink mode 2. |
| 32. NR\_SL\_enh | 32-6b | Inter-UE coordination in NR sidelink mode 2(UE-A w/ reception of PSFCH-based indication) | 1) UE can receive PSFCH-like based indication for scheme 2 in NR sidelink mode 2 and use the received information in its own resource (re-)selection in NR sidelink mode 2. |

 |
| [16] | 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] [32-2] [32-3] [32-4] | [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.  |

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] [32-3] [32-4] [32-X] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 2 in NR sidelink mode 2. | Per band | N.A. | N.A. | N.A. |  | Optional with capability signalling.  |

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, i.e., reception of all SL signalling, or 32-2, i.e., reception of only PSFCH and S-SSB.
* 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 proposal 4-1:**

* **FG 32-5 is split to two FGs as follows**
	+ **FG 32-5a: Inter-UE coordination scheme 1 in NR sidelink mode 2**
	+ **FG 32-5b: Inter-UE coordination scheme 2 in NR sidelink mode 2**

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| 32. NR\_SL\_enh | 32-5a | 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 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].FFS whether/how to split FG 32-5a into multiple FGs | [TBD] | [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. |
| 32. NR\_SL\_enh | 32-5b | 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.FFS whether/how to split FG 32-5b into multiple FGs | [TBD] | [Yes] | [Yes] | UE does not support inter-UE coordination scheme 2 in NR sidelink mode 2. | [Per band] | N.A. | N.A. | N.A. |  | Optional with capability signalling. |

Note that any contents highlighted in yellow mean FFS and to be discussed further.

* + - *Support: Huawei, HiSilicon, CATT, GOHIGH, Intel, ZTE, Sanechips, Samsung, DOCOMO, Ericsson*

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| Company | Comment |
| vivo | Considering that the two sub-schemes of scheme 1 (namely preferred and non-preferred resources) are considered for different use cases/devices, we still think it is worth taking one more step to split FG 35-5a into two FGs for two sub-schemes respectively. We are fine with the proposed 32-5b. |
| Qualcomm | We agree with vivo’s point about splitting 32-5a. There are interoperability testing considerations in addition to the implementation ones.We also propose to separate at least Scheme 1 with preferred resource set indication based on transmission or reception of inter-UE coordination information to accommodate low-power devices that rely on inter-UE coordination for resource selection for example. |
| Apple | We are fine with the proposal. We think further split of FG is needed, but can discuss it in a later stage.  |
| OPPO | We are fine with the proposal. Furthermore, we suggest to further split 32-5a and 32-5b based on transmission and reception of inter-UE coordination, as the pre-requisites for them are different. |
| NTT DOCOMO | Support. Whether/how to split is included as FFS, so current version should be fine. |
| Huawei, HiSilicon | We support this proposal.There are two inter-UE coordination schemes, thus the two schemes can be associated with different UE capability to support different inter-UE coordination operation. It is reasonable to define two UE FGs for the two schemes. |

**Medium priority question 4-2:**

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

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| Company | Comment |
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**Medium priority question 4-3:**

* **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”**
	+ *Yes: Huawei, HiSilicon*
	+ *No: OPPO*

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| Company | Comment |
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**Medium priority question 4-4:**

* **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”**
	+ *Yes: OPPO*

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**Low priority question 4-5:**

* **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 |
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**Low priority question 4-6:**

* **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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# **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#107-e meeting.

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| --- | --- | --- |
| [5] | vivo | The Rel-17 NR sidelink enhancement only targets NR specific enhancements. There is no impact to LTE sidelink, nor any LTE/NR sidelink interaction. Consequently, there should not be any impact to a Rel-17 UE supports LTE sidelink only. For a Rel-17 UE supports both LTE sidelink and enhanced NR sidelink, it should report the Rel-17 related UE features in NR sidelink only. Therefore, in our view the Rel-17 NR sidelink enhancement should have no impact to LTE UE feature.*Observation 1: The Rel-17 NR sidelink enhancement WI has no impact to LTE UE feature.* |
| [8] | Intel Corporation |

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| --- |
| * Discuss whether Rel-17 UE features for SL enhancement should be included in the LTE features list
 |

We think it can be discussed further whether to support configuration for inter-UE coordination of NR UEs. We do not see this issue as high priority and can check further once R17 UE feature list for sidelink is stabilized. |
| [10] | ZTE, Sanechips | The discussion of LTE features shall be pending the finalization of NR feature list. Afterwards, the LTE feature list can be updated by re-using the NR feature list to accommodate the LTE Uu scheduling NR sidelink use case.1. LTE UE features can mostly re-use stable NR feature list.
 |
| [16] | Ericsson | In our view, 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. Nevertheless, we think that this discussion can be taken once the NR UE feature list is stable and all the FGs are agreed.1. Discuss the LTE SL UE features for Rel-17 once the NR SL UE features for Rel-17 are stable.
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## **Discussion**

**Low priority proposal 5-1:**

* **The discussion of LTE UE features for Rel-17 NR sidelink enhancement is postponed until Rel-17 NR SL FGs are stable**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | OK to wait. We wanted to point out that the reason to consider the LTE FG list is to allow the Rel-17 SL enh features to be used when the NR SL is used in an LTE cell, e.g. so that power saving does not vanish when an NR SL UE enters an LTE cell. Similar for inter-UE coordination not failing when moving into LTE coverage areas. RAN2 would have no issue with higher layer support. |
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# **Other FGs**

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

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| --- | --- | --- |
| [3] | Huawei, HiSilicon | We assume RAN2 will handle the definition of capabilities related to SL DRX without input from RAN1. |
| [8] | Intel Corporation |

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| --- |
| * Discuss whether to add and FG for reevaluation of selected resources
 |

In our view, current design of re-evaluation checking is not power efficient especially for the case of semi-persistent transmission, due to the need to perform periodic sensing and re-evaluation for each transmission period. We do not think that such functionality must be supported by all UEs and therefore we are supportive to have additional FG for this specific functionality.

|  |
| --- |
| * Discuss whether to add and FG for preemption checking for reserved resources
 |

In our view, current design of preemption checking is not power efficient especially for the case of semi-persistent transmission, due to the need to perform periodic sensing and preemption checking for each transmission period. We do not think that such functionality must be supported by all UEs and therefore we are supportive to have additional FG for this specific functionality unless other mechanism to address this aspect is enabled.**For partial sensing based semi-persistent transmissions, continue discussion on the best way to address UE power consumption for pre-emption checking by design enhancement or through definition of the new UE FG** |
| [14] | Qualcomm Incorporated | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | 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. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |

 |
| [16] | Ericsson | In our view, it is important to include as a component for each of the FG related to transmitting using any of the resource allocation schemes, i.e., full-sensing, partial sensing and random resource selection, the procedure done by the UE of performing reselection and re-evaluation/pre-emption checking of the resources. Similar to the procedure used during Rel-16, it is not needed to include a separate FG for these operations, but they can be defined as components for each of the resource allocation schemes.1. Similar to the approach used in Rel-16 SL UE features, there is no need to include a separate FG for re-selection and/or re-evaluation/pre-emption checking.

For the case of UEs without sensing capabilities as in random resource selection only re-selection of resources is needed, while for full-sensing and partial sensing both reselection and re-evaluation/pre-emption checking are needed. There is no need to include a separate FG for this procedure.1. Include the procedure of re-selection and re-evaluation/pre-emption checking as components to each of the resource allocation schemes.
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## **Discussion**

**High priority question 6-1:**

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

|  |  |
| --- | --- |
| Company | Comment |
| FL | This question can be discussed after some progress is made for proposal 3-1 |

**High priority question 6-2:**

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

|  |  |
| --- | --- |
| Company | Comment |
| FL | This question can be discussed after some progress is made for proposal 3-1 |

# **Conclusions**

TBD

# **References**

[1] R1-2110587 Updated RAN1 UE features list for Rel-17 NR after RAN1 #106bis-e Moderators (AT&T, NTT DOCOMO, INC.)

[2] R1-2110588 Updated RAN1 UE features list for Rel-17 LTE after RAN1 #106bis-e Moderators (AT&T, NTT DOCOMO, INC.)

[3] R1-2110846 Rel-17 UE features for NR sidelink enhancement Huawei, HiSilicon

[4] R1-2110888 UE features for NR sidelink enhancement FUTUREWEI

[5] R1-2111058 UE features for NR sidelink enhancement vivo

[6] R1-2111238 Further discussion on Rel-17 UE features for sidelink enhancements CATT, GOHIGH

[7] R1-2111302 On UE feature list for NR sidelink enhancement OPPO

[8] R1-2111534 UE Features for NR Sidelink Enhancements Intel Corporation

[9] R1-2111561 Discussion on Rel-17 UE features on sidelink enhancement Xiaomi

[10] R1-2111638 Discussion on UE features for NR sidelink enhancement ZTE, Sanechips

[11] R1-2111778 UE features for NR sidelink enhancement Samsung

[12] R1-2111913 Views on Rel-17 NR Sidelink UE Features Apple

[13] R1-2112143 Discussion on Rel.17 UE features for NR SL enhancement NTT DOCOMO, INC.

[14] R1-2112256 UE Features for Sidelink Enhancements Qualcomm Incorporated

[15] R1-2112306 Views on UE features for NR sidelink enhancements MediaTek Inc.

[16] R1-2112354 UE features for NR sidelink enhancement Ericsson