**3GPP TSG-RAN WG1 Meeting #108-e *R1-22xxxxx***

**E-Meeting, 21 February – 3 March, 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **[DRAFT] CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **37.985** | **CR** | **xxx** | **rev** | **-** | **Current version:** | **17.0.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Introduction of Rel-17 sidelink enhancements and concurrent Uu-PC5 bands | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei (editor) | | | | | | | | | |
| ***Source to TSG:*** | R1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SL\_enh-Core | | | | |  | ***Date:*** | | | 2022-03-10 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1. NR sidelink transmission profiles are not present, and an NR sidelink DRX text proposal has been provided by RAN2 in R1-2202935. 2. Rel-16 purposes of SCI and PSFCH do not include inter-UE coordination. 3. Cast types usable for scheme 1 inter-UE coordination are not stated. 4. LTE and NR sidelink Uu-PC5 concurrent operation bands have been updated in RAN4 big CRs R4-2204172, R4-2204173, R4-2204174. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Add NR sidelink transmission profiles, and RAN2 TP on NR sidelink DRX. 2. Add use of SCI and PSFCH for inter-UE coordination schemes. 3. Add statement of cast types usable for inter-UE coordination. 4. Add and update concurrent Uu-PC5 bands from RAN4 big CRs for TS 38.101-1 and TS 38.101-3. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Incomplete description of Rel-17 NR sidelink enhancements relevant to V2X. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.1.3, 6.2.1, 6.2.6, 6.8, 8, 9.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |

## <Unchanged parts omitted>

5.1.3 Concurrent operation and carrier aggregation

V2X operation is defined in band 47 in TS 36.101 [11, clause 5.5G], which supports single-carrier and multi-carrier operation:

**Table 5.1.3-1: V2X operating band**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E‑UTRA Operating Band** | **E-UTRA V2X Operating Band** | **V2X UE transmit** | | | **V2X UE receive** | | | **Duplex Mode** | **Interface** |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| 47 | 47 | 5855 MHz |  | 5925 MHz | 5855 MHz |  | 5925 MHz | HD | PC5 |

The V2X sidelink in band 47 can be operated concurrently with Uu FDD bands 3, 5, 7, 8, 20, 28, 71; Uu TDD bands 34, 39, 41; and NR Uu bands n1, n8, n39, n40, n71, n78, n79.

## <Unchanged parts omitted>

## 6.2 V2X sidelink physical layer

### 6.2.1 Physical sidelink channels and signals

## <Unchanged parts omitted>

Sidelink control information (SCI) in NR V2X is transmitted in two stages. The first-stage SCI is carried on PSCCH and contains information to enable sensing operations, information about the resource allocation of the PSSCH, and, when needed, indication that the UE can receive conflict information in inter-UE coordination.

PSSCH transmits the second-stage SCI and the SL-SCH transport channel. The second-stage SCI can carry information needed to identify and decode the associated SL-SCH, as well as control for HARQ procedures, triggers for CSI feedback, inter-UE coordination requests and information, etc. SL-SCH carries the TB of data for transmission over SL.

<Unchanged parts omitted>

When used for HARQ purposes, PSFCH carries HARQ feedback over the sidelink from a UE which is an intended recipient of a PSSCH transmission (henceforth an Rx UE) to the UE which performed the transmission (henceforth a Tx UE). Sidelink HARQ feedback may be in the form of conventional ACK/NACK, or NACK-only with nothing transmitted in case of successful decoding; for more information refer to clause 6.2.4. PSFCH can also convey inter-UE coordination information; refer to clause 6.8.

PSFCH transmits a Zadoff-Chu sequence in one PRB repeated over two OFDM symbols, the first of which can be used for AGC, near the end of the sidelink resource in a slot. The time resources for PSFCH are (pre-)configured to occur once in every 1, 2, or 4 slots. Frequency/code resources are derived implicitly from those used by the associated PSSCH transmission, together with the L1 identity of the UE transmitting PSSCH and, when groupcast with ACK/NACK feedback is used, the identity within the group of the UE transmitting PSFCH.

<Unchanged parts omitted>

### 6.2.6 Concurrent operation

NR-V2X operation is defined in bands n38, n47 and n79 in TS 38.101-1 [22, clause 5.2E], which support single-carrier operation:

Table 6.2.6-1: NR-V2X operating bands

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| V2X Operating Band | Sidelink (SL) Transmission operating band | | | Sidelink (SL) Reception operating band | | | Duplex Mode | Interface |
|  | FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |  |  |
| n381 | 2570 MHz | - | 2620 MHz | 2570 MHz | - | 2620 MHz | HD | PC5 |
| n47 | 5855 MHz | - | 5925 MHz | 5855 MHz | - | 5925 MHz | HD | PC5 |
| n79 | 4400 MHz | - | 5000 MHz | 4400 MHz | - | 5000 MHz | HD | PC5 |
| Note 1: When this band is used for V2X SL service, the band is exclusively used for NR V2X in particular regions. | | | | | | | | |

The NR-V2X sidelink in band n38 can be operated concurrently with LTE Uu band 20. The NR-V2X sidelink in band n47 can be operated concurrently with Uu bands 1, 3, 8, 39, 40, 41, n1, n8, n39, n40, n41, n71, n78, and n79. The NR-V2X sidelink in band n79 can be operated concurrently with Uu band n79.

## <Unchanged parts omitted>

## 6.8 Inter-UE coordination

NR-V2X UEs may exchange information with one another over sidelink which can aid the resource allocation mode 2 (re-)selection procedure.

There are two schemes for doing so, where UE-B has a sidelink transmission to perform and receives coordination information from UE-A:

1. A UE-A can provide to another UE-B indications of resources that are preferred to be included in UE-B's (re-)selected resources, or preferred to be excluded. When given resources to include, UE-B may rely only on those resources, at least if it does not support sensing/resource exclusion, or may combine them with resources identified by its own sensing procedure, before making a final selection.

Transmissions of, and requests for, coordination information are sent by UE-A or UE-B, respectively, in a MAC-CE and may also, if the UE supports the function, be sent in a 2nd-stage SCI. Coordination information can be in response to a request from UE-B, or due to an internal cause at UE-A. A request is sent in unicast to UE-A, which responds also in unicast. When due to an internal cause, UE-A uses unicast to indicate resources preferred to be included, and unicast, groupcast or broadcast to indicate resources preferred to be excluded.

2. A UE-A can provide to another UE-B an indication that resources reserved for UE-B's transmission (which may or may not be to UE-A) will be, or could be, subject to conflict with a transmission from another UE. UE-B can then re-select new resources to replace them.

The indication from UE-A is a PSFCH sent to UE-B in resources which are (pre-)configured separately from those for SL-HARQ operation, and from which UE-B can derive which of its transmissions is indicated for re-selection.

In both schemes, UE-A can identify resources according to a number of conditions which are based on the SL-RSRP of the resources in question as a function of the traffic priority, and/or whether UE-A would be unable to receive a transmission from UE-B, due to performing its own transmission, i.e. a half-duplex problem. The purpose of this exchange of information is to give UE-B information about resource occupancy acquired by UE-A which it might not be able to determine on its own due to hidden nodes, exposed nodes, persistent collisions, etc.

<Unchanged parts omitted>

# 8 Transmission profiles

LTE-V2X was developed over the course of two 3GPP Releases, Rel-14 and Rel-15. In Rel-15, non-backward compatible changes to physical transmission formats were introduced, primarily to support the use of 64-QAM on PSSCH compared to the maximum of 16-QAM in Rel-14. Such transmissions cannot be decoded by Rel-14 UEs. However, on sidelink, a transmitting UE cannot know the Release of specifications supported by the UEs which will receive the PSSCH transmission, since the transmission is broadcast in the physical layer. Therefore, the concept of transmission profiles was introduced, which associates to each transmission by a Rel-15 UE a (pre-)configuration of which Release's transmission format to use. A transmitting UE performs transmission format selection based on the profile indicated by higher layer of the 3GPP protocol stack. If a Rel-14 format is indicated, then the transmission can be decoded by both Releases of UE, whereas if Rel-15 format is indicated, it can be decoded only by Rel-15 UEs. When a UE has traffic from different application sources to transmit at the same time, the transmission profile associated with the highest-priority traffic is applied. The association of transmission profiles to traffic sources (specifically, logical channels) is provided by 3GPP protocol layers outside of RAN.

Transmission profiles are also defined in NR, for the support of sidelink DRX, which was introduced in Rel-17; see Clause 9.3. This is to ensure compatibility for sidelink groupcast and broadcast between UEs supporting and not supporting sidelink DRX, since a receiver UE would miss transmissions sent in its DRX inactive times. Only if all those transmission profiles of interest to the receiver UE correspond to support of sidelink DRX does the UE assume it can be used. Similarly, a transmitting UE only assumes sidelink DRX is used by its groupcast or broadcast receiver UEs when the relevant transmission profile corresponds to support of sidelink DRX.

# 9 Battery-limited UEs

## <Unchanged parts omitted>

## 9.3 Sidelink DRX

To aid in power consumption reduction for P-UEs, as well as other applications, NR-V2X supports DRX operation on sidelink. It is similar to DRX on the Uu interface, with DRX active and inactive times occurring on a periodically-repeating cycle. In the DRX active part of the cycle, full or partial sensing is performed as usual, together with reception and decoding of PSCCH, PSSCH, etc. In the DRX inactive part, a UE only performs reception of PSCCH and SL-RSRP measurements for sensing. When resource (re-)selection is performed, the physical layer ensures that at least a subset of the resources reported to the MAC layer are within the active time of the UE to which the intended transmission will be sent.

Sidelink DRX is supported for unicast, groupcast, and broadcast. For unicast, sidelink DRX is configured per pair of source L2 ID and destination L2 ID. A receiver UE may send assistance information to the transmitter UE to assist the determination of the sidelink DRX configuration for the receiver UE. The receiver UE may accept or reject the configuration via PC5-RRC signalling.

For groupcast and broadcast, sidelink DRX is configured based on QoS profile and destination L2 ID with multiple configurations supported. UE needs to perform down selection on cycle/timers when multiple QoS profiles are configured for one destination L2 ID. A default sidelink DRX configuration can be used for a QoS profile which cannot be mapped to any configuration for the dedicated QoS profile(s). Transmission profiles are defined for groupcast and broadcast to ensure backward compatibility; refer to Clause 8. A transmission profile is indicated from upper layers to AS layers, and includes at least the information of whether or not sidelink DRX is supported.

Alignment of Uu DRX and sidelink DRX for a receiver UE in RRC\_CONNECTED state is supported for unicast, groupcast, and broadcast.

Details of the sidelink DRX operation are specified in TS 38.321 [21, clause 5.x].

<Unchanged parts omitted>