**3GPP TSG- Meeting # *R1-21xxxxx***

**, 11-19 November 2021**

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| *CR-Form-v12.1* |
| **[DRAFT] CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
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| *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 |
|  |  |
| ***Source to WG:*** | Huawei (editor) |
| ***Source to TSG:*** | R1 |
|  |  |
| ***Work item code:*** | NR\_SL\_enh-Core |  | ***Date:*** |  |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *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 canbe 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:*** | Inclusion of sidelink enhancement features applicable to NR V2X |
|  |  |
| ***Summary of change:*** | Addition of inter-UE coordination and UE power saving enhancements |
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| ***Consequences if not approved:*** | Incomplete description of RAN aspects of NR V2X |
|  |  |
| ***Clauses affected:*** | 3.3, 6.8(new), 9, 9.1(new), 9.2(new), 9.3(new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  |   |
| ***affected:*** |  | **X** |  Test specifications |   |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |   |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**<Unchanged parts are omitted>**

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

Where the same abbreviation is used for LTE V2X and NR V2X, which is meant can be derived from the clause within which it appears, unless otherwise stated.

5GC Fifth Generation core network

AGC Automatic gain control

AMBR Aggregate maximum bit rate

BSM Basic safety message

BWP Bandwidth part

CA Carrier aggregation

CAM Cooperative awareness message

CBR Channel busy ratio

CPS Contiguous partial sensing

CR Channel occupancy ratio

DENM Decentralized environmental notification message

DMRS Demodulation reference signal

DRX Discontinuous reception

EPC Evolved packet core

MBSFN Multicast-broadcast single-frequency network

MNO Mobile network operator

PBPS Periodic-based partial sensing

PPPP ProSe per-packet priority

PPPR ProSe per-packet reliability

PSBCH Physical sidelink broadcast channel

PSCCH Physical sidelink control channel

PSSCH Physical sidelink shared channel

PSSS, S-PSS Primary sidelink synchronization signal (LTE), sidelink primary synchronization signal (NR)

PT-RS Phase-tracking reference signal

P-UE Pedestrian UE

RSU Roadside unit

SA Scheduling assignment

SCI Sidelink control information

SC-PTM Single-cell point-to-multipoint

SL-BCH Sidelink broadcast channel

SLSS Sidelink synchronization signal

S-RSSI Sidelink received signal strength indicator

S-SSB Sidelink synchronization signal block

SSSS, S-SSS Secondary sidelink synchronization signal (LTE), sidelink secondary synchronization signal (NR)

V2I Vehicle-to-infrastructure

V2P Vehicle-to-pedestrian

V2V Vehicle-to-vehicle

V2X Vehicle-to-everything

**<Unchanged parts are omitted>**

6 NR V2X

**<Unchanged parts are 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:

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 when UE-B does not support sensing/resource exclusion, or may add to them resources identified by its own sensing procedure, before making a final selection.

The coordination information is sent by UE-A in a MAC-CE and/or a 2nd-stage SCI, and can be in response to a request from UE-B, or due to an internal cause at UE-A.

2. A UE-A can provide to another UE-B an indication that resources selected 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 local to UE-A which it might not be able to determine on its own due to hidden nodes, exposed nodes, persistent collisions, etc. For example, in the first scheme, when providing resources preferred to be included due to low SL-RSRP levels for the traffic priority, UE-A performs essentially its own local sensing and resource selection procedure on behalf of UE-B, and informs UE-B of the result. While when identifying resources for UE-B to exclude, UE-A can signal those it experiences with high SL-RSRP, i.e. interfered at UE-A, or low SL-RSRP, i.e. weak signal for receiving UE-B's transmission at UE-A. Resources needing re-selection in the second scheme are identified by UE-A on a similar basis.

**<Unchanged parts are omitted>**

9 Pedestrian UE

9.1 Power supply

LTE-V2X, as discussed in Clause 4, and NR-V2X both include communications between Pedestrian UEs and Vehicular UEs, i.e. V2P. Whereas a vehicular UE is assumed to be attached to the vehicle's power supply, and thus to have no particular battery life concerns, the situation is different for a P-UE. A P-UE could be, e.g. a conventional smartphone running suitable applications, or a specialised device attached to a pedestrian's clothing, etc. In either case, battery life has to be considered so that the device will provide the V2P services for a reasonable length of time without need of re-charging, and without imposing such battery drain that V2P applications could become unattractive.

9.2 Partial sensing

As described in Clause 5.2.2.2, a LTE-V2X UE performs sensing continuously in a 1000 ms historical window, implying an amount of ongoing power consumption due to the sensing procedure. It is allowed for a LTE P-UE to not support sidelink reception, so that it is only broadcasting packets relating to its own location and direction. This type of P-UE is allowed, if a resource pool's (pre-)configuration permits, to select transmission resources randomly, with no sensing procedure. For a LTE P-UE which does support sidelink reception, it can be permitted by (pre-)configuration to perform partial sensing. In partial sensing, only a subset of the subframes in the typically 1000 ms sensing window have to be monitored. The LTE UE implementation can choose how few subframes it wishes to monitor, by trading off the reliability of its transmissions with the power saving, subject to monitoring a (pre-)configured minimum number. (Pre-)configuration can also set how far into the past the sensing window extends, and can require that the UE performs partial sensing in a number of these truncated sensing windows.

In NR-V2X, there are two similar power-saving resource allocation methods which, as well as being applicable to P-UEs, are also intended to have applicability to non-V2X applications. As with LTE-V2X, a UE is allowed, if a resource pool's (pre-)configuration permits, to select transmission resources randomly, with no sensing procedure. To retain the higher reliability provided by sidelink HARQ, the resources selected must still obey the constraints of HARQ feedback preparation time, and allow successive re-transmission resources to be signalled in the reach of one SCI.

For partial sensing in NR-V2X, there is a need to account for the wider set of targeted periodicities, and also for aperiodic traffic. Partial sensing therefore has two parts: periodic-based (PBPS), and contiguous (CPS). PBPS is similar to the LTE-V2X partial sensing, where a UE chooses a set of *Y* candidate slots, subject to a minimum number, and monitors that set. The UE can be (pre-)configured to monitor the *Y* slots at least according to a subset or the whole set of periodicities configured in the resource pool. When traffic arrives at slot *n*, sensing information from either the most recent one, or the most recent two, monitoring occasions of *Y* slots at each relevant periodicity is used in performing resource (re-)selection. PBPS is designed to provide sufficient sensing information to manage resource allocation for periodic traffic, whilst providing configurability to balance sensing accuracy with power consumption. On its own, PBPS may not be sufficient for detecting aperiodic traffic. For this purpose, CPS is performed in each of *M* sidelink slots ending shortly before the first of the *Y* candidates. *M* can be (pre-)configured to balance detection of aperiodic SCIs with UE power consumption. An example of this combined PBPS and CPS operation is shown in Figure 9.1. It is also possible for the UE to perform only CPS, if the resource pool does not permit periodic reservations.

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**Figure 9.1: Example of NR partial sensing. PBPS of *Y* candidate slots at two periodicities, *P*1 and *P*2, for the two most recent PBPS occasions before slot *n,* and CPS for *M* sidelink slots ending a processing time before the *Y* candidate slots.**

For partial sensing applied to periodic transmissions, re-evaluation and pre-emption are also performed before the resources are used (see Clause 6.3.2.2) for the remaining PBPS candidate slots, and CPS slots preceding them.

9.3 Sidelink DRX

*Editor’s note: To be provided primarily by RAN2.*

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 can perform reception of PSCCH and SL-RSRP measurements for sensing. This reduces the knowledge of resource occupancy in the system, but also reduces the power consumption of sidelink operation. 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.

**<Unchanged parts are omitted>**