**3GPP TSG-RAN WG1 Meeting #110bis-e *R1-22xxxxx***

**E-meeting, October 10-19, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **37.985** | **CR** | xxxx | **rev** | **-** | **Current version:** | **17.1.1** |  |
|  | | | | | | | | |
| *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 | **X** | Radio Access Network | **X** | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Introduction of sidelink relay and sidelink discovery | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | … | | | | | | | | | |
| ***Source to TSG:*** | R1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SL\_Relay-Core | | | | |  | ***Date:*** | | | 2022-10-xx |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***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 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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | SL relay and discovery operation are agreed to be added to TR 37.985. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Add SL relay and SL discovery operation. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Incomplete description of RAN aspects of V2X | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3, 6.9 (new), 6.9.1 (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | Temporary note: Change-on-change will be tidied up in a potential final CR | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*Start Change*

# Introduction

The 3GPP platform was first expanded to the automotive industry by the introduction of support for V2V and V2X services in Release 14. This support forms Phase 1 of 3GPP's ongoing project relating to V2X, and was intended to support a set of requirements sufficient for basic road safety services. Vehicles containing UEs with these features can use the uplink, downlink and sidelink to exchange information on their own status, such as position, speed, and heading with other nearby vehicles, infrastructure nodes, and pedestrians. Phase 2 of the V2X project was standardised in Release 15, and adds a number of new features to the sidelink intended to enhance efficiency and exploit developments in UE and network designs. These enhancements include sidelink carrier aggregation, higher-order modulation, and reduced latency.

Phase 3 of V2X, in Release 16, adds support to NR (and also 5GC, not addressed in this TR) for advanced V2X use cases, and includes introduction of the NR sidelink. The use-cases are broadly grouped to enable vehicular platooning, exchange of extended sensor information, advanced driving, and remote driving. Phase 3 also allows either RAT's sidelink to be operated under control of the other RAT's Uu interface, as well as permitting connection to EPC or 5GC, to enable usage in the main MR-DC deployment scenarios.

Sidelink relay and sidelink discovery features have also been specified. Although developed originally as generic sidelink features, they may also be of relevance to some V2X use cases.

In the following clauses, LTE-V2X is described first, then NR-V2X, and finally certain aspects which have a degree of commonality to both RATs.

Although this TR deals with RAN aspects, note that the core network architectures also have many adaptations to support V2X in both EPC and 5GC. These are referred to only as needed for other explanations in this TR, and details can be found in the relevant specifications.

<Unchanged text omitted>

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 36.885: "Study on LTE-based V2X Services".

[3] ETSI EN 302 637-2: "Specification of Cooperative Awareness Basic Service".

[4] SAE J2735: "Dedicated Short Range Communications (DSRC) Message Set Dictionary".

[5] ETSI EN 302 637-3 "Specifications of Decentralized Environmental Notification Basic Service".

[6] 3GPP TS 22.185: "Service requirements for V2X services".

[7] 3GPP TS 22.186: "Enhancement of 3GPP support for V2X scenarios".

[8] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".

[9] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[10] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)".

[11] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[12] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Measurements".

[13] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[14] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC)".

[15] 3GPP TS 36.323: "Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP)".

[16] 3GPP TS 38.211: "NR; Physical channels and modulation".

[17] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[18] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[19] 3GPP TS  37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity; Stage 2".

[20] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".

[21] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[22] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[23] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS)".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

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

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 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

L2 Layer-2

L3 Layer-3

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

SRAP Sidelink Relay Adaptation Protocol

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)

U2N UE-to-network

V2I Vehicle-to-infrastructure

V2P Vehicle-to-pedestrian

V2V Vehicle-to-vehicle

V2X Vehicle-to-everything

*Next Change*

## 6.9 Sidelink relay

Sidelink-based U2N relaying functionality is specified to support network coverage extension and power efficiency. L2 and L3 U2N relay architectures are supported.

For L3 U2N relays, the corresponding architecture is transparent to the serving RAN of the L3 U2N Relay UE, except for sidelink resources control. The detailed architecture and procedures for L3 U2N relay can be found in TS 23.304 [23].

For L2 U2N relays, the L2 U2N Remote UE establishes the RRC connection with gNB via a L2 U2N Relay UE. A single unicast link is established between one L2 U2N Relay UE and one L2 U2N Remote UE. The protocol stacks for user plane and control plane of the L2 U2N Relay architecture are shown in Figure 6.9-1 and Figure 6.9-2, which are in clause 16.12.2.1 in TS 38.300 [20]. A new sublayer, the SRAP sublayer is placed above the RLC sublayer for both CP and UP via the PC5 interface and Uu interface for bearer mapping purpose. The SRAP header includes the Uu RB ID of the L2 U2N Remote UE and a local Remote UE ID. The SRAP sublayer of L2 U2N Relay UE performs bearer mapping according to the local Remote UE ID and Uu RB ID included in the PC5 SRAP header and Uu SRAP headers.



Figure 6.9-1: User plane protocol stack for L2 U2N relay



Figure 6.9-2: Control plane protocol stack for L2 U2N relay

For both L3 U2N relays and L2 U2N relays, the U2N Remote UE needs to perform U2N relay discovery (see clause 6.9.1) and relay (re)selection. For relay (re)selection, a U2N Relay UE is considered suitable by a U2N Remote UE in terms of radio criteria if the PC5 link quality measured by U2N Remote UE towards the U2N Relay UE exceeds (pre)configured threshold. The U2N Remote UE searches for suitable U2N Relay UE candidates that meet all AS layer and higher layer criteria. If there are multiple suitable U2N Relay UEs, it is up to U2N Remote UE implementation to choose one among them.

Once the U2N Remote UE selects a suitable U2N Relay UE, it establishes the PC5 connection with the U2N Relay UE. For L2 U2N Remote UE, it needs to further establish its own PDU sessions and DRBs with the network before user plane data transmission. The RRC connection management for L2 U2N Remote UE is specified in clause 16.12.5.1 of TS 38.300 [20].

The in-coverage L2 U2N Remote UE is allowed to acquire any necessary SIB(s) over the Uu interface irrespective of its PC5 connection to L2 U2N Relay UE. The L2 U2N Remote UE can also receive the system information from the L2 U2N Relay UE after PC5 connection establishment with L2 U2N Relay UE.

When the L2 U2N Relay UE and L2 U2N Remote UE are both in RRC IDLE or RRC INACTIVE, the L2 U2N Relay UE monitors paging occasions of its connected U2N Remote UE(s). When L2 U2N Relay UE is in RRC CONNECTED and L2 U2N Remote UE(s) is in RRC\_IDLE or RRC\_INACTIVE, the L2 U2N Relay UE may monitor the POs of its connected L2 U2N Remote UE(s) or receive the L2 U2N Remote UE’s paging via dedicated RRC message from the gNB. Upon receving the paging message, the L2 U2N Relay UE sends the relevant paging record to the L2 U2N Remote UE(s) accordingly.

For purpose of service continuity of L2 U2N relay, the L2 U2N Remote UE is switched between indirect and direct paths. The detailed procedures for path switching are specified in clause 16.12.6 of TS 38.300 [20].

### 6.9.1 Sidelink discovery

The UE may perform NR sidelink discovery while in-coverage or out-of-coverage for L2 relay, L3 relay, and non-relay operation. There are two discovery models, Model A and Model B, which are defined in TS 23.304 [23]. The protocol stack used for discovery is presented in Figure 6.9.1-1 as specified in clause 16.12.3 of TS 38.300 [20].



Figure 6.9.1-1: Protocol stack of sidelink discovery

For L2 and L3 relay discovery, the network may broadcast or configure via dedicated signalling, a threshold, which is used by the U2N Remote UE to determine if it can transmit relay discovery messages to U2N relay UE(s). The network may also broadcast, or configure via dedicated signalling, a maximum Uu RSRP threshold and/or a minimum Uu RSRP threshold, which are used by the U2N Relay UE to determine if it can transmit relay discovery messages to U2N Remote UE(s).

For L2 and L3 relay discovery, the resource pool(s) used for NR sidelink communication can be used for relay discovery or the network may configure a resource pool(s) dedicated for relay discovery. Whether to configure dedicated resource pool(s) for relay discovery is a network implementation choice.*End of Change*