**3GPP TSG-RAN WG2 Meeting #109-e *R2-2002264***

**E-meeting, February 24-28, March 2-6, 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  | **38.300** | **CR** | **0204** | **rev** | **-** | **Current version:** | **16.0.0** |  |
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| *For* [***HELP***](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 5G V2X with NR Sidelink |
|  |  |
| ***Source to WG:*** | LG Electronics Inc. |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | 5G\_V2X\_NRSL-Core |  | ***Date:*** | 2020-03-02 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-16 |
|  | *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-12 (Release 12)Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | 5G V2X with NR sidelink is introduced in REL-16. |
|  |  |
| ***Summary of change:*** | In this version of the CR, we propose the followings that were not agreed yet:* The AS protocol stack of NR SBCCH is same as the stack of LTE SBCCH.
* One-to-many PC5-RRC messages are not supported in Rel-16 (This is currently FFS in Editor’s Note).

RAN2#106 (Endorsed in R2-1908299):* New abbreviations and definitions are added to 3.2.
* Uu RRC supports for sidelink are added to 7.1, 7.3 and 7.9.
* New section 16.x is added for introduction of sidelink operation.

RAN2#107 (Endorsed in R2-1911682):* One missing RAN2#105B agreement is captured in 7.3.1.
* Minor editorial changes to 16.x.2.2 and 16.x.2.6 in yellow from R2-1908299.
* RAN2#107 agreements are captured.
* Fixed “NR Sidelink” that start with a uppercase letter to start with an lower case (i.e., “NR sidelink”)

RAN2#107bis (Endorsed in R2-14000)* RAN2#107bis agreements are captured.

RAN2#108 (Endorsed in R2-1916638)* New sidelink transport channels are introduced in 5.5
* Sidelink related identities are added in 8.x.
* PC5-RRC release is added and some texts related to PC5-RRC are reordered in 16.x.2.6
* Example signaling flows are added to 16.x.4.2 and 16.x.4.3 with modifications to the existing texts, based on new agreements.

RAN2#109-e* T400 expiry condition is added in 16.x.2.6
* All editor’s notes are deleted
* Capturing RAN1 input to Rel-16 TS 38.300 in R1-2001355
 |
|  |  |
| ***Consequences if not approved:*** | 5G V2X with NR Sidelink will not be introduced in Rel-16. |
|  |  |
| ***Clauses affected:*** | 2, 3.1, 3.2, 7.1, 7.3, 7.9, 16.x |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 36.300 CR 1271, TS 37.340 CR 0187  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

START OF THE CHANGE

# 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 TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[3] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[4] 3GPP TS 38.401: "NG-RAN; Architecture description".

[5] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".

[6] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[7] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".

[8] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[9] 3GPP TS 37.324: " E-UTRA and NR; Service Data Protocol (SDAP) specification".

[10] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in Idle mode and RRC Inactive state".

[11] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[12] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[13] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[14] 3GPP TS 22.168: "Earthquake and Tsunami Warning System (ETWS) requirements; Stage 1".

[15] 3GPP TS 22.268: "Public Warning System (PWS) Requirements".

[16] 3GPP TS 38.410: "NG-RAN; NG general aspects and principles".

[17] 3GPP TS 38.420: "NG-RAN; Xn general aspects and principles".

[18] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[19] 3GPP TS 22.261: "Service requirements for next generation new services and markets".

[20] 3GPP TS 38.202: "NR; Physical layer services provided by the physical layer"

[21] 3GPP TS 37.340: "NR; Multi-connectivity; Overall description; Stage-2".

[22] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[23] IETF RFC 4960 (2007-09): "Stream Control Transmission Protocol".

[24] 3GPP TS 26.114: "Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[25] Void.

[26] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".

[27] IETF RFC 3168 (09/2001): "The Addition of Explicit Congestion Notification (ECN) to IP".

[28] 3GPP TS 24.501: "NR; Non-Access-Stratum (NAS) protocol for 5G System (5GS)".

[29] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[30] 3GPP TS 38.415: "NG-RAN; PDU Session User Plane Protocol".

[xx] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services ".

[xy] 3GPP TS 23.285: "Technical Specification Group Services and System Aspects; Architecture enhancements for V2X services".

# 3 Abbreviations and Definitions

## 3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] 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] and TS 36.300 [2].

5GC 5G Core Network

5QI 5G QoS Identifier

A-CSI Aperiodic CSI

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

ARP Allocation and Retention Priority

BA Bandwidth Adaptation

BCH Broadcast Channel

BPSK Binary Phase Shift Keying

C-RNTI Cell RNTI

CBRA Contention Based Random Access

CCE Control Channel Element

CD-SSB Cell Defining SSB

CFRA Contention Free Random Access

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

DFT Discrete Fourier Transform

DCI Downlink Control Information

DL-SCH Downlink Shared Channel

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

ETWS Earthquake and Tsunami Warning System

GFBR Guaranteed Flow Bit Rate

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

LDPC Low Density Parity Check

MDBV Maximum Data Burst Volume

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

MMTEL Multimedia telephony

MNO Mobile Network Operator

MU-MIMO Multi User MIMO

NCGI NR Cell Global Identifier

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NGAP NG Application Protocol

NR NR Radio Access

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PO Paging Occasion

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PSS Primary Synchronisation Signal

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

QPSK Quadrature Phase Shift Keying

RA-RNTI Random Access RNTI

RACH Random Access Channel

RANAC RAN-based Notification Area Code

REG Resource Element Group

RIM Remote Interference Management

RMSI Remaining Minimum SI

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RNTI Radio Network Temporary Identifier

RQA Reflective QoS Attribute

RQoS Reflective Quality of Service

RS Reference Signal

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SFI-RNTI Slot Format Indication RNTI

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SMC Security Mode Command

SMF Session Management Function

S-NSSAI Single Network Slice Selection Assistance Information

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRS Sounding Reference Signal

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TPC Transmit Power Control

UCI Uplink Control Information

UL-SCH Uplink Shared Channel

UPF User Plane Function

URLLC Ultra-Reliable and Low Latency Communications

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

## 3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] 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] and TS 36.300 [2].

**Cell-Defining SSB:** an SSB with an RMSI associated.

**CORESET#0**: the control resource set for at least SIB1 scheduling, can be configured either via MIB or via dedicated RRC signalling.

**gNB**: node providing NR user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**Intra-system Handover:** Handover that does not involve a CN change (EPC or 5GC).

**Inter-system Handover:** Handover that involves a CN change (EPC or 5GC).

**MSG1**: preamble transmission of the random access procedure.

**MSG3**: first scheduled transmission of the random access procedure.

**ng-eNB**: node providing E-UTRA user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**NG-C**: control plane interface between NG-RAN and 5GC.

**NG-U**: user plane interface between NG-RAN and 5GC.

**NG-RAN node**: either a gNB or an ng-eNB.

**Numerology**: corresponds to one subcarrier spacing in the frequency domain. By scaling a reference subcarrier spacing by an integer *N*, different numerologies can be defined.

**NR sidelink communication**: AS functionality enabling at least V2X communication as defined in TS 23.287 [xx], between two or more nearby UEs, using NR technology but not traversing any network node.

**V2X sidelink communication**: AS functionality enabling V2X communication as defined in TS 23.285 [xy], between nearby UEs, using E-UTRA technology but not traversing any network node.

**Xn:** network interface between NG-RAN nodes.

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## 5.5 Transport Channels

The physical layer offers information transfer services to MAC and higher layers. The physical layer transport services are described by *how* and with what characteristics data are transferred over the radio interface. An adequate term for this is "Transport Channel". This should be clearly separated from the classification of *what* is transported, which relates to the concept of logical channels at MAC sublayer.

Downlink transport channel types are:

1. **Broadcast Channel (BCH)** characterised by:

- fixed, pre-defined transport format;

- requirement to be broadcast in the entire coverage area of the cell, either as a single message or by beamforming different BCH instances.

2. **Downlink Shared Channel (DL-SCH)** characterised by:

- support for HARQ;

- support for dynamic link adaptation by varying the modulation, coding and transmit power;

- possibility to be broadcast in the entire cell;

- possibility to use beamforming;

- support for both dynamic and semi-static resource allocation;

- support for UE discontinuous reception (DRX) to enable UE power saving.

3. **Paging Channel (PCH)** characterised by:

- support for UE discontinuous reception (DRX) to enable UE power saving (DRX cycle is indicated by the network to the UE);

- requirement to be broadcast in the entire coverage area of the cell, either as a single message or by beamforming different BCH instances;

- mapped to physical resources which can be used dynamically also for traffic/other control channels.

Uplink transport channel types are:

1. **Uplink Shared Channel (UL-SCH)** characterised by:

- possibility to use beamforming;

- support for dynamic link adaptation by varying the transmit power and potentially modulation and coding;

- support for HARQ;

- support for both dynamic and semi-static resource allocation.

2. **Random Access Channel(s) (RACH)** characterised by:

- limited control information;

- collision risk.

Sidelink transport channel types are:

1. **Sidelink broadcast channel (SL-BCH)** characterised by:

- pre-defined transport format.

2. **Sidelink shared channel (SL-SCH)** characterised by:

- support for unicast transmission, groupcast transmission and broadcast transmission;

- support for both UE autonomous resource selection and scheduled resource allocation by NG-RAN;

- support for both dynamic and semi-static resource allocation when UE is allocated resources by the NG-RAN;

- support for HARQ;

- support for dynamic link adaptation by varying the transmit power, modulation and coding.

Association of transport channels to physical channels is described in TS 38.202 [20].

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5.x Sidelink

5.x.1 General

Sidelink supports UE-to-UE direct communication using the transmission mode, physical-layer signals/channels, and physical layer procedures below.

5.x.2 Sidelink resource allocation modes

Two sidelink resource allocation modes are supported mode 1 and mode 2. In mode 1, the sidelink resource allocation is provided by the network. In mode 2, UE decides the SL transmission resources and timing in the resource pool.

5.x.3 Physical sidelink channels and signals

Physical sidelink control channel (PSCCH) indicates resource and other transmission parameters used by a UE for PSSCH. PSCCH transmission is associated with a DM-RS.

Physical Sidelink Shared Channel (PSSCH) transmits the resource allocation for the TBs of data for transmission, the TBs of data themselves, and control information for HARQ procedures and CSI feedback triggers, etc. At least 5 OFDM symbols within a slot are used for PSSCH transmission. PSSCH transmission is associated with a DM-RS and may be associated with a PT-RS.

Physical sidelink feedback channel (PSFCH) carries HARQ feedback over the sidelink from a UE which is an intended recipient of a PSSCH transmission to the UE which performed the transmission. PSFCH sequence is transmitted in one PRB repeated over two OFDM symbols near the end of the sidelink resource in a slot.

The Sidelink Synchronization Signal consists of sidelink primary and sidelink secondary synchronization signals (S-PSS, S-SSS), each occupying 2 symbols and 127 subcarriers. Physical Sidelink Broadcast Channel (PSBCH) occupies 7 and 5 symbols for normal and extended cyclic prefix cases respectively, including the associated DM-RS.

5.x.4 Physical layer procedures for sidelink

5.x.4.1 HARQ feedback

Sidelink HARQ feedback uses PSFCH and can be operated in one of two options. In one option, PSFCH transmits either ACK or NACK using a resource dedicated to a single PSFCH transmitting UE. In another option, PSFCH transmits NACK, or no PSFCH signal is transmitted, on a resource that can be shared by multiple PSFCH transmitting UEs.

In sidelink resource allocation mode 1, a UE which received PSFCH can report sidelink HARQ feedback to gNB via PUCCH or PUSCH.

5.x.4.2 Power Control

For in-coverage operation, the power spectral density of the sidelink transmissions can be adjusted based on the pathloss from the gNB.

For unicast, the power spectral density of some sidelink transmissions can be adjusted based on the pathloss between the two communicating UEs.

5.x.4.3 CSI report

For unicast, channel state information reference signal (CSI-RS) is supported for CSI measurement and reporting in sidelink. A CSI report is carried in a MAC CE.

5.x.5 Physical layer measurement definition

For measurement on the sidelink, the following UE measurement quantities are supported:

- PSBCH Sidelink reference signal received power (PSBCH-SL RSRP)

- PSSCH reference signal received power (PSSCH-RSRP)

- PSСCH reference signal received power (PSCCH-RSRP)

- Sidelink received signal strength indicator (SL RSSI)

- Sidelink channel occupancy ratio (SL CR)

- Sidelink channel busy ratio (SL CBR)

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# 7 RRC

## 7.1 Services and Functions

The main services and functions of the RRC sublayer over the Uu interface include:

- Broadcast of System Information related to AS and NAS;

- Paging initiated by 5GC or NG-RAN;

- Establishment, maintenance and release of an RRC connection between the UE and NG-RAN including:

- Addition, modification and release of carrier aggregation;

- Addition, modification and release of Dual Connectivity in NR or between E-UTRA and NR.

- Security functions including key management;

- Establishment, configuration, maintenance and release of Signalling Radio Bearers (SRBs) and Data Radio Bearers (DRBs);

- Mobility functions including:

- Handover and context transfer;

- UE cell selection and reselection and control of cell selection and reselection;

- Inter-RAT mobility.

- QoS management functions;

- UE measurement reporting and control of the reporting;

- Detection of and recovery from radio link failure;

- NAS message transfer to/from NAS from/to UE.

The sidelink specific services and functions of the RRC sublayer over the Uu interface include:

- Configuration of sidelink resource allocation via system information or dedicated signalling;

- Reporting of UE sidelink information;

- Measurement configuration and reporting related to sidelink:

- Reporting of UE assistance information for SL traffic pattern(s).

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## 7.3 System Information Handling

### 7.3.1 Overview

System Information (SI) consists of a MIB and a number of SIBs, which are divided into Minimum SI and Other SI:

- **Minimum SI** comprises basic information required for initial access and information for acquiring any other SI. Minimum SI consists of:

- *MIB* contains cell barred status information and essential physical layer information of the cell required to receive further system information, e.g. CORESET#0 configuration. *MIB* is periodically broadcast on BCH.

- *SIB1* defines the scheduling of other system information blocks and contains information required for initial access. SIB1 is also referred to as Remaining Minimum SI (RMSI) and is periodically broadcast on DL-SCH or sent in a dedicated manner on DL-SCH to UEs in RRC\_CONNECTED.

- **Other SI** encompasses all SIBs not broadcast in the Minimum SI. Those SIBs can either be periodically broadcast on DL-SCH, broadcast on-demand on DL-SCH (i.e. upon request from UEs in RRC\_IDLE or RRC\_INACTIVE), or sent in a dedicated manner on DL-SCH to UEs in RRC\_CONNECTED. Other SI consists of:

- *SIB2* contains cell re-selection information, mainly related to the serving cell;

- *SIB3* contains information about the serving frequency and intra-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB4* contains information about other NR frequencies and inter-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB5* contains information about E-UTRA frequencies and E-UTRA neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB6* contains an ETWS primary notification;

- *SIB7* contains an ETWS secondary notification;

- *SIB8* contains a CMAS warning notification;

- *SIB9* contains information related to GPS time and Coordinated Universal Time (UTC).

For sidelink, Other SI also includes:

- *SIBx* contains information related to NR sidelink communication;

- *SIBy* contains information related to *SystemInformationBlockType21* for V2X sidelink communication as specified in TS 36.331 clause 5.2.2.28 [29]

- *SIBz* contains information related to *SystemInformationBlockType26* for V2X sidelink communication as specified in TS 36.331 clause 5.2.2.33 [29].

Figure 7.3-1 below summarises System Information provisioning.



Figure 7.3-1: System Information Provisioning

For a cell/frequency that is considered for camping by the UE, the UE is not required to acquire the contents of the minimum SI of that cell/frequency from another cell/frequency layer. This does not preclude the case that the UE applies stored SI from previously visited cell(s).

If the UE cannot determine the full contents of the minimum SI of a cell by receiving from that cell, the UE shall consider that cell as barred.

In case of BA, the UE only acquires SI on the active BWP.

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## 7.9 UE Assistance Information

When configured to do so, the UE can signal the network through *UEAssistanceInformation* if it prefers an adjustment in the connected mode DRX cycle length, or if it is experiencing internal overheating. In the latter case, the UE can express a preference for temporarily reducing the number of maximum secondary component carriers, the maximum aggregated bandwidth and the number of maximum MIMO layers. In both cases, it is up to the gNB whether to accommodate the request.

For sidelink, the UE can report SL traffic pattern(s) to NG-RAN, for periodic traffic.

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## 8.x NR sidelink communication and V2X sidelink communication related identities

The following identities are used for NR sidelink communication:

- Source Layer-2 ID: Identifies the sender of the data in NR sidelink communication. The Source Layer-2 ID is 24 bits long and is split in the MAC layer into two bit strings;

- One bit string is the LSB part (8 bits) of Source Layer-2 ID and forwarded to physical layer of the sender. This identifies the source of the intended data in sidelink control information and is used for filtering of packets at the physical layer of the receiver.

- Second bit string is the MSB part (16 bits) of the Source Layer-2 ID and is carried within the MAC header. This is used for filtering of packets at the MAC layer of the receiver.

- Destination Layer-2 ID: Identifies the target of the data in NR sidelink communication. For NR sidelink communication, the Destination Layer-2 ID is 24 bits long and is split in the MAC layer into two bit strings:

- One bit string is the LSB part (16 bits) of Destination Layer-2 ID and forwarded to physical layer of the sender. This identifies the target of the intended data in sidelink control information and is used for filtering of packets at the physical layer of the receiver.

- Second bit string is the MSB part (8 bits) of the Destination Layer-2 ID and is carried within the MAC header. This is used for filtering of packets at the MAC layer of the receiver.

- PC5 Link Identifier: Uniquely identifies the PC5 unicast link in a UE for the lifetime of the PC5 unicast link as specified in TS 23.287 [xx]. The PC5 Link Identifier is used to indicate the PC5 unicast link whose sidelink RLF declaration was made and PC5-RRC connection was released.

V2X sidelink communication related identities are specified in clause 8.3 of TS 36.300 [2].

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## 16.x Sidelink

### 16.x.1 General

In this subclause, an overview of NR sidelink communication and how NG-RAN supports NR sidelink communication and V2X sidelink communication is given. V2X sidelink communication are specified in TS 36.300 [2].

The NG-RAN architecture supports the PC5 interface as illustrated in Figure 16.x.1-1. Sidelink transmission and reception over the PC5 interface are supported when the UE is inside NG-RAN coverage, irrespective of which RRC state the UE is in, and when the UE is outside NG-RAN coverage.



Figure 16.x.1-1: NG-RAN Architecture supporting the PC5 interface

Support of V2X services via the PC5 interface can be provided by NR sidelink communication and/or V2X sidelink communication. NR sidelink communication may be used to support other services than V2X services.

NR sidelink communication can support one of three types of transmission modes for a pair of a Source Layer-2 ID and a Destination Layer-2 ID in the AS:

- **Unicast transmission**, characterized by:

- Support of one PC5-RRC connection between peer UEs for the pair;

- Transmission and reception of control information and user traffic between peer UEs in sidelink;

- Support of sidelink HARQ feedback;

- Support of RLC AM;

- Detection of radio link failure for the PC5-RRC connection.

- **Groupcast transmission**, characterized by:

- Transmission and reception of user traffic among UEs belonging to a group in sidelink;

- Support of sidelink HARQ feedback.

- **Broadcast transmission**, characterized by:

- Transmission and reception of user traffic among UEs in sidelink;

### 16.x.2 Radio Protocol Architecture for NR sidelink communication

#### 16.x.2.1 Overview

The AS protocol stack for the control plane in the PC5 interface consists of RRC, PDCP, RLC and MAC sublayers, and the physical layer. The protocol stack of PC5-C for RRC is shown in Figure 16.x.2.1-1.



Figure 16.x.2.1-1: PC5 control plane (PC5-C) protocol stack for RRC.

For support of PC5-S protocol specified in TS 23.287 [xx], PC5-S is located on top of PDCP, RLC and MAC sublayers, and the physical layer for the control plane in the PC5 interface as shown in Figure 16.x.2.1-2.



Figure 16.x.2.1-2: PC5 control plane (PC5-C) protocol stack for PC5-S.

The AS protocol stack for SBCCH in the PC5 interface consists of RRC, RLC, MAC sublayers, and the physical layer as shown below in Figure 16.x.2.1-3.



Figure 16.x.2.1-3: PC5 control plane (PC5-C) protocol stack for SBCCH.

The AS protocol stack for user plane in the PC5 interface consists of SDAP, PDCP, RLC and MAC sublayers, and the physical layer. The protocol stack of PC5-U is shown in Figure 16.x.2.1-4.



Figure 16.x.2.1-4: PC5 user plane (PC5-U) protocol stack.

Sidelink Radio bearers (SLRB) are categorized into two groups: sidelink data radio bearers (SL DRB) for user plane data and sidelink signalling radio bearers (SL SRB) for control plane data. Separate SL SRBs using different SCCHs are configured for PC5-RRC and PC5-S signaling respectively.

#### 16.x.2.2 MAC

The MAC sublayer provides the following services and functions over the PC5 interface in addition to the services and functions specified in subclause 6.2.1:

- Radio resource selection;

- Packet filtering;

- Priority handling between uplink and sidelink transmissions for a given UE;

- Sidelink CSI reporting.

With LCP restrictions in MAC, only sidelink logical channels belonging to the same destination can be multiplexed into a MAC PDU for every unicast, groupcast and broadcast transmission which is associated to the destination. NG-RAN can also control whether a sidelink logical channel can utilise the resources allocated to a configured sidelink grant Type 1(see subclause 10.x).

For packet filtering, a SL-SCH MAC header including portions of both Source Layer-2 ID and a Destination Layer-2 ID is added to each MAC PDU as specified in subclause 8.x. LCID included within a MAC subheader uniquely identifies a logical channel within the scope of the Source Layer-2 ID and Destination Layer-2 ID combination.

The following logical channels are used in sidelink:

- Sidelink Control Channel (SCCH): a sidelink channel for transmitting control information from one UE to other UE(s);

- Sidelink Traffic Channel (STCH): a sidelink channel for transmitting user information from one UE to other UE(s);

- Sidelink Broadcast Control Channel (SBCCH): a sidelink channel for broadcasting sidelink system information from one UE to other UE(s).

The following connections between logical channels and transport channels exist:

- SCCH can be mapped to SL-SCH;

- STCH can be mapped to SL-SCH;

- SBCCH can be mapped to SL-BCH.

#### 16.x.2.3 RLC

The services and functions of the RLC sublayer as specified in subclause 6.3.2 are supported for sidelink. TM is used for SBCCH. Either UM or AM is used in unicast transmission while UM is used in groupcast or broadcast transmission. For UM, only uni-directional transmission is supported for groupcast and broadcast.

#### 16.x.2.4 PDCP

The services and functions of the PDCP sublayer as specified in subclause 6.4.1 are supported for sidelink with some restrictions:

- Out-of-order delivery is supported only for unicast transmission;

- Duplication is not supported over the PC5 interface.

#### 16.x.2.5 SDAP

The SDAP sublayer provides the following service and function over the PC5 interface:

- Mapping between a QoS flow and a sidelink data radio bearer.

There is one SDAP entity per destination for one of unicast, groupcast and broadcast which is associated to the destination. Reflective QoS is not supported over the PC5 interface.

#### 16.x.2.6 RRC

The RRC sublayer provides the following services and functions over the PC5 interface:

- Transfer of a PC5-RRC message between peer UEs;

- Maintenance and release of a PC5-RRC connection between two UEs;

- Detection of sidelink radio link failure for a PC5-RRC connection.

A PC5-RRC connection is a logical connection between two UEs for a pair of Source and Destination Layer-2 IDs which is considered to be established after a corresponding PC5 unicast link is established as specified in TS 23.287 [xx]. There is one-to-one correspondence between the PC5-RRC connection and the PC5 unicast link. A UE may have multiple PC5-RRC connections with one or more UEs for different pairs of Source and Destination Layer-2 IDs.

Separate PC5-RRC procedures and messages are used for a UE to transfer UE capability and sidelink configuration including SLRB configuration to the peer UE. Both peer UEs can exchange their own UE capability and sidelink configuration using separate bi-directional procedures in both sidelink directions.

If it is not interested in sidelink transmission, if sidelink RLF on the PC5-RRC connection is declared, or if the Layer-2 link release procedure is completed as specified in TS 23.287 [xx] or if the T400 is expired as specified in TS 38.331 [12], UE releases the PC5-RRC connection.

### 16.x.3 Radio Resource Allocation

#### 16.x.3.1 General

The UE can operate in two modes for resource allocation in sidelink:

- Scheduled resource allocation, characterized by:

- The UE needs to be RRC\_CONNECTED in order to transmit data;

- NG-RAN schedules transmission resources.

- UE autonomous resource selection, characterized by:

- The UE can transmit data when inside NG-RAN coverage, irrespective of which RRC state the UE is in, and when outside NG-RAN coverage;

- The UE autonomously selects transmission resources from a pool of resources.

* For NR sidelink communication, the UE performs sidelink transmissions only on a single carrier.

#### 16.x.3.2 Scheduled Resource Allocation

NG-RAN can dynamically allocate resources to the UE via the SL-RNTI on PDCCH(s) for NR sidelink Communication.

In addition, NG-RAN can allocate sidelink resources to UE with two types of configured sidelink grants:

* With type 1, RRC directly provides the configured sidelink grant only for NR sidelink communication
* With type 2, RRC defines the periodicity of the configured sidelink grant while PDCCH can either signal and activate the configured sidelink grant, or deactivate it. The PDCCH is addressed to SL-CS-RNTI for NR sidelink communication and SL Semi-Persistent Scheduling V-RNTI for V2X sidelink communication.

For the UE performing NR sidelink communication, there can be more than one configured sidelink grant activated at a time on the carrier configured for sidelink transmission.

When beam failure or physical layer problem occurs on NR Uu, the UE can continue using the configured sidelink grant Type 1. During handover, the UE can be provided with configured sidelink grants via handover command, regardless of the type. If provided, the UE activates the configured sidelink grant Type 1 upon reception of the handover command.

The UE can send sidelink buffer status report to support scheduler operation in NG-RAN. The sidelink buffer status reports refer to the data that is buffered in for a group of logical channels (LCG) per destination in the UE. Eight LCGs are used for reporting of the sidelink buffer status reports. Two formats, which are SL BSR and truncated SL BSR, are used.

#### 16.x.3.3 UE Autonomous Resource Selection

The UE autonomously selects sidelink grant from a pool of resources provided by broadcast system information or dedicated signalling while inside NG-RAN coverage or by preconfiguration while outside NG-RAN coverage.

For NR sidelink communication, the pools of resources can be provided for a given validity area where the UE does not need to acquire a new pool of resources while moving within the validity area, at least when this pool is provided by SIB (e.g. reuse valid area of NR SIB). NR SIB validity mechanism is reused to enable validity area for SL resource pool configured via broadcasted system information.

The UE is allowed to temporarily use UE autonomous resource selection with random selection for sidelink transmission based on configuration of the exceptional transmission resource pool as specified in TS 38.331 [12].

### 16.x.4 Uu Control

#### 16.x.4.1 General

When a UE is inside NG-RAN coverage, NR sidelink communication and/or V2X sidelink communication can be configured and controlled by NG-RAN via dedicated signaling or system information:

- The UE should support and be authorized to perform NR sidelink communication and/or V2X sidelink communication in NG-RAN;

- If configured, the UE performs V2X sidelink communication as specified in TS 36.300 [2] unless otherwise specified;

- NG-RAN can provide the UE with intra-carrier sidelink configuration, inter-carrier sidelink configuration and anchor carrier which provides sidelink configuration via a Uu carrier for NR sidelink communication and/or V2X Sidelink communication;

- When the UE cannot simultaneously perform both NR sidelink transmission and NR uplink transmission in time domain, prioritization between both transmissions is done based on their priorities and thresholds configured by the NG-RAN.

When a UE is outside NG-RAN coverage, SLRB configuration are preconfigured to the UE for NR sidelink communication.

#### 16.x.4.2 Control of connected UEs

The UE in RRC\_CONNECTED performs NR sidelink communication and/or V2X sidelink communication. The UE sends Sidelink UE Information to NG-RAN in order to request or release sidelink resources and report QoS information for each destination. For the unicast transmission, the Sidelink UE Information may report the established PC5 unicast link after the PC5 unicast link has been successfully established.

NG-RAN provides *RRCReconfiguration* to the UE in order to provide the UE with dedicated sidelink configuration. The *RRCReconfiguration* may include SLRB configuration for NR sidelink communication as well as either sidelink scheduling configuration or resource pool configuration. If UE has received SLRB configuration via system information, UE should continue using the configuration to perform sidelink data transmissions and receptions until a new configuration is received via the *RRCReconfiguration*.

NG-RAN may also configure measurement and reporting of CBR and reporting of location information to the UE via *RRCReconfiguration*.

During handover, the UE performs sidelink transmission and reception based on configuration of the exceptional transmission resource pool or configured sidelink grant Type 1 and reception resource pool of the target cell as provided in the handover command.

#### 16.x.4.3 Control of idle/inactive UEs

The UE in RRC\_IDLE or RRC\_INACTIVE performs NR sidelink communication and/or V2X sidelink communication. NG-RAN may provide common sidelink configuration to the UE in RRC\_IDLE or RRC\_INACTIVE via system information for NR sidelink communication and/or V2X sidelink communication. UE receives resource pool configuration and SLRB configuration via *SIBX* for NR sidelink communication as specified in TS 38.331 [12], and/or resource pool configuration via *SIBY* and *SIB*Z for V2X sidelink communication as specified in TS 38.331 [12]. If UE has received SLRB configuration via dedicated signaling, UE should continue using the configuration to perform sidelink data transmissions and receptions until a new configuration is received via system information.

When the UE performs cell reselection, the UE interested in V2X service(s) considers at least whether NR sidelink communication and/or V2X sidelink communication are supported by the cell. The UE may consider the following carrier frequency as the highest priority frequency, except for the carrier only providing the anchor carrier:

- the frequency providing both NR sidelink communication and V2X sidelink communication, if configured to perform both NR sidelink communication and V2X sidelink communication;

- the frequency providing NR sidelink communicaion, if configured to perform only NR sidelink communication.

END OF THE CHANGE