ETSI TS 122 185 V17.0.0 (2022-04)

LTE;
Service requirements for V2X services
(3GPP TS 22.185 version 17.0.0 Release 17)

3GPP™
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Reference
RTS/TSGS-0122185vh00

Keywords
VEHICLE

ETSI

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Sous-Préfecture de Grasse (06) N° w061004871

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present document provides 3GPP support for V2X service requirements to be supported by LTE transport. These requirements are identified by taking into account the V2X service requirements defined in other SDOs, e.g. ETSI ITS, US SAE. The specification includes requirements of safety and non-safety aspects.

2 References

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

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

[2] 3GPP TR 22.885: "Study on LTE Support for V2X Services".

[3] ETSI TR 102 638 V1.1.1: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Definitions".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP 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 3GPP TR 21.905 [1].

Road Side Unit: A stationary infrastructure entity supporting V2X applications that can exchange messages with other entities supporting V2X applications.

NOTE: RSU is a term frequently used in existing ITS specifications, and the reason for introducing the term in the 3GPP specifications is to make the documents easier to read for the ITS industry. RSU is a logical entity that supports V2X application logic using the functionality provided by either a 3GPP network or an UE (referred to as UE-type RSU).

Pseudonymity: The condition when the processing of personally identifiable information is such the data can no longer be attributed to a specific subscriber without the use of additional information, as long as such additional information is kept separately and subject to technical and organisational measures to ensure non-attribution to an identified or identifiable subscriber.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

RSU	Road Side Unit
V2I	Vehicle-to-Infrastructure
V2N	Vehicle-to-Network
V2P	Vehicle-to-Pedestrian
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything

4 Overview on V2X (informative)

4.1 Types of V2X application support in 3GPP

4.1.1 General

The V2X applications in the present specification, referred to as Vehicle-to-Everything (V2X), contain the following four different types:

- Vehicle-to-Vehicle (V2V)
- Vehicle-to-Infrastructure (V2I)
- Vehicle-to-Network (V2N)
- Vehicle-to-Pedestrian (V2P)

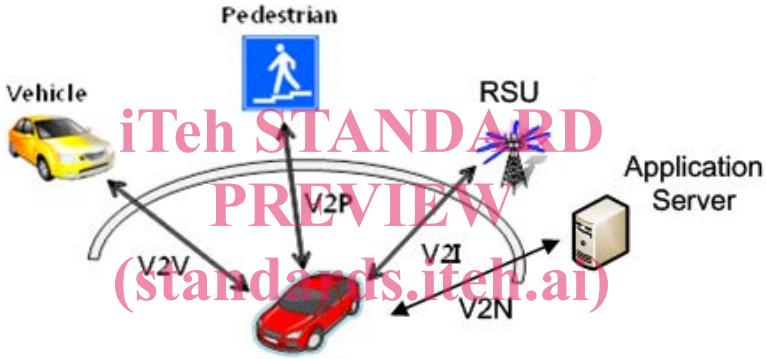

Figure 4.1.1-1: Types of V2X applications (V2V, V2P, V2N and V2I)

These four types of V2X applications can use "co-operative awareness" to provide more intelligent services for end-users. This means that entities, such as vehicles, roadside infrastructure, application server and pedestrians, can collect knowledge of their local environment (e.g., information received from other vehicles or sensor equipment in proximity) to process and share that knowledge in order to provide more intelligent services, such as cooperative collision warning or autonomous driving.

These intelligent transportation services and the associated message sets have been defined in automotive SDOs outside 3GPP. Three basic classes of applications for providing ITS services: road safety, traffic efficiency, and other applications can be found in e.g., [3].

3GPP only handles the transport of these messages to support different types of V2X applications. The message transport expectations are described in requirements defined in this specification.

4.1.2 Vehicle-to-Vehicle (V2V) application

V2V applications expect UEs that are in proximity of each other to exchange V2V application information. 3GPP transport of messages containing V2V application information requires the UE to have a valid subscription and authorization from a network operator. Transport for a valid subscriber is provided whether the UE is served or not served by E-UTRAN.

The UE supporting V2V applications transmits messages containing V2V application information (e.g. location, dynamics, and attributes). The message payloads may be flexible in order to accommodate varying amount of information.

3GPP transport of message containing V2V application information is predominantly broadcast-based as illustrated in Figure 4.1-2. Such 3GPP transport includes the transport between UEs directly and/or, due to the limited direct communication range, the transport between UEs via infrastructure supporting V2X communication, e.g., RSU, application server, etc.

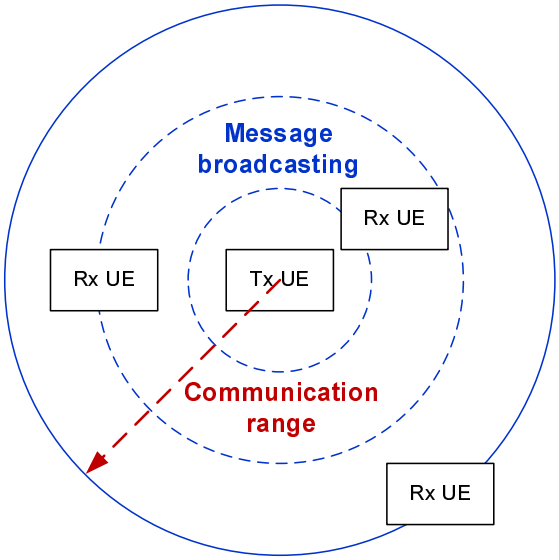

Figure 4.1.2-1: Broadcast-based V2V communications

4.1.3 Vehicle-to-Infrastructure (V2I) application

The UE supporting V2I applications transmits messages containing V2I application information to an RSU or locally relevant application server. The RSU and/or the locally relevant application server transmit messages containing V2I application information to one or more UEs supporting V2I applications.

A locally relevant application server serves a particular geographic area. There can be multiple application servers serving overlapping areas, providing the same or different applications.

4.1.4 Vehicle-to-Network (V2N) application

The UE supporting V2N applications communicates with an application server supporting V2N applications. Both parties communicate with each other via EPS.

4.1.5 Vehicle-to-Pedestrian (V2P) application

V2P applications expect UEs that are in proximity of each other to exchange V2P application information. 3GPP transport of messages containing V2P application information requires the UE to have a valid subscription and authorization from a network operator. Transport for a valid subscriber is provided whether the UE is served or not served by E-UTRAN.

The UE supporting V2P applications transmits messages containing V2P application information. It is expected that V2P application information can be transmitted either by a UE supporting V2X application in a vehicle (e.g., warning to pedestrian), or by a UE supporting V2X application associated with a vulnerable road user (e.g., warning to vehicle).

3GPP transport of messages containing V2P application information includes the transport between UEs directly and/or, due to the limited direct communication range, the transport between UEs via infrastructure supporting V2X communication, e.g., RSU, application server, etc.

NOTE: The main difference between 3GPP transport of messages with V2P and V2V application information is due to the properties of the UE. A UE supporting V2P applications used by pedestrian might, for example, have lower battery capacity, the radio sensitivity might be limited, e.g. due to antenna design, and therefore it may not be able to send messages with the same periodicity as UEs supporting V2V application, and/or receive messages.

4.2 Relative priority of V2X communication

Subject to regional/national regulatory requirements and operator policies, certain mission critical services (e.g. Public Safety, MPS) can be relatively prioritized over transport of V2X application information. Transport of safety-related V2X application information can be prioritized over transport of non-safety-related V2X application information.

However, in general, it is expected that operator can control relative priorities of different services.

5 Requirements

5.1 Overall Requirements

[R-5.1-001] The message transmission shall be under control of the 3GPP network when the transmitting UE is served by the E-UTRAN.

[R-5.1-002] A UE supporting V2X application shall be able to be pre-configured by the 3GPP network with parameters to be used for the transmission and reception of messages when not served by E-UTRAN supporting V2X communication.

[R-5.1-003] A UE supporting V2X application shall be able to transmit and receive messages when served or not served by E-UTRAN supporting V2X communication.

[R-5.1-004] An RSU shall be able to transmit/receive messages to/from a UE supporting V2X application.

[R-5.1-005] The 3GPP system shall be able to support message transfer between UEs when served or not served by the same PLMN supporting V2X communications.

[R-5.1-006] The 3GPP system shall be able to provide means to prioritize message transmission among UEs supporting V2X application

[R-5.1-007] The 3GPP system shall be able to provide means to prioritize transmission of messages according to their type (e.g. safety vs. non-safety).

[R-5.1-008] The 3GPP system shall be able to vary the transmission rate and range of the V2X communication based on service conditions (e.g., UE speed, UE density).

[R-5.1-009] The 3GPP system shall be able to distribute information in a resource efficient way to large numbers of UEs supporting V2X application.

[R-5.1-010] A UE supporting V2X application shall be able to identify whether E-UTRAN supports V2X communication.

[R-5.1-011] The 3GPP system shall be able to provide means for an application server and the RSU to control the area and the size of the area where the messages are being distributed.

[R-5.1-011a] The 3GPP system shall be able to provide means for distribution of messages from a UE supporting V2X application to locally relevant application servers.

[R-5.1-012] The E-UTRA(N) shall be able to support a high density of UEs supporting V2X application.

[R-5.1-013] Both the HPLMN and VPLMN operators shall be able to charge for network resource usage when messages are transferred by a UE supporting V2X application.

[R-5.1-014] For UE supporting V2X application with limited resources (e.g., battery), the impact on its resources (e.g., battery consumption) due to message transfer should be minimized.

[R-5.1-015] The 3GPP network should make available any supported positional accuracy improvement techniques (e.g., DGPS and/or OTDOA) in a resource efficient way to a subscribed UE supporting V2X application.

5.2 Specific Service Requirements

5.2.1 Latency/ Reliability Requirements

[R-5.2.1-001] The E-UTRA(N) shall be capable of transferring messages between two UEs supporting V2V/P application, directly or via an RSU, with a maximum latency of 100ms.

[R-5.2.1-002] For particular usage (i.e., pre-crash sensing) only, the E-UTRA(N) should be capable of transferring messages between two UEs supporting V2V application with a maximum latency of 20ms.

[R-5.2.1-003] The E-UTRA(N) shall be capable of transferring messages between a UE supporting V2I application and an RSU with a maximum latency of 100ms.

[R-5.2.1-004] The E-UTRAN shall be capable of transferring messages via 3GPP network entities between a UE and an application server both supporting V2N application with an end-to-end delay no longer than 1000 ms.

[R-5.2.1-005] The E-UTRA(N) shall be able to support high reliability without requiring application-layer message retransmissions.

5.2.2 Message Size Requirements

[R-5.2. 2-001] The E-UTRA(N) shall be capable of transferring periodic broadcast messages between two UEs supporting V2X application with variable message payloads of 50-300 bytes, not including security-related message component.

[R-5.2. 2-002] The E-UTRA(N) shall be capable of transferring event-triggered messages between two UEs supporting V2X application with variable message payloads which can be up to 1200 bytes, not including security-related message component.

NOTE: 3GPP only handles the transport of messages for V2X services/applications based on message characteristics (e.g., latency, message size) and is agnostic to message types.

5.2.3 Frequency Requirements

[R-5.2.3-001] The E-UTRA(N) shall be able to support a maximum frequency of 10 messages per second per transmitting UE .

NOTE: It is assumed that V2X application provides messages to 3GPP layer for transport either periodically and/or triggered by certain events.

5.2.4 Range Requirements

[R-5.2.4-001] The E-UTRAN shall be capable of supporting a communication range sufficient to give the driver(s) ample response time (e.g. 4 seconds).

5.2.5 Speed Requirements

[R-5.2.5-001] The 3GPP system shall be capable of transferring messages between UEs supporting V2V application, while the maximum relative velocity of the UEs is 500 km/h, regardless of whether the UE(s) are served or not served by E-UTRAN supporting V2X communication.

[R-5.2.5-002] The 3GPP system shall be capable of transferring messages between UEs supporting V2V and V2P application, respectively, while the UE's maximum absolute velocity is 250 km/h, regardless of whether the UE(s) are served or not served by E-UTRAN supporting V2X communication.

[R-5.2.5-003] The 3GPP system shall be capable of transferring messages between a UE and an RSU both supporting V2I application, while the UE's maximum absolute velocity is 250 km/h, regardless of whether the UE or the RSU is served or not served by E-UTRAN supporting V2X communication.