ETSI TS 122 186 V15.4.0 (2018-10)

5G;
Service requirements for enhanced V2X scenarios
(3GPP TS 22.186 version 15.4.0 Release 15)

Reference

RTS/TSGS-0122186vf40

Keywords

5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

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

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document specifies service requirements to enhance 3GPP support for V2X scenarios in the 3GPP systems (i.e. EPS, 5G).

It includes transport layer support for both safety and non-safety V2X scenarios:

- Safety-related V2X scenarios: e.g. automated driving, vehicle platooning
- Non-safety-related V2X scenarios: e.g., mobile high data rate entertainment, mobile hotspot/office/home, dynamic digital map update

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 22.261: "Service requirements for the 5G system".

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

[4] SAE International, "AUTOMATED DRIVING LEVELS OF DRIVING AUTOMATION ARE DEFINED IN NEW SAE INTERNATIONAL STANDARD J3016", December 2016; US Homeland Security Digital Library, "Self-Driving Cars: Levels of Automation", March 2017 https://www.hsdl.org/?view&did=801463.

[5] ISO TS 17419:2014: "Intelligent Transport Systems - Cooperative systems - Classification and management of ITS applications in a global context".

[6] IEEE Std 1609.0-2013: "IEEE Guide for Wireless Access in Vehicular Environments (WAVE) architecture".

3 Definitions, symbols 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].

End-to-end latency: Time it takes to transfer a given piece of information from a source to a destination, measured at the application level, from the moment it is transmitted by the source to the moment it is received at the destination.

Reliability (%): The success probability of transmitting X bytes within a certain delay, which is the time it takes to deliver a small data packet from the radio protocol layer 2/3 SDU ingress point to the radio protocol layer 2/3 SDU egress point of the radio interface.

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).

For the purposes of the present document, the following terms and definitions given in ISO TS 17419 [5] apply:
ITS Application Identifier: globally unique, registered number identifying an ITS application object
For the purposes of the present document, the following term and definition given in IEEE Std 1609.0 [6] apply:
Provider Service Identifier: An identifier of an application-service provided by a higher layer entity.

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].

ITS	Intelligent Transport Systems
ITS-AID	ITS Application Identifier
LoA	Level of Automation
PSID	Provider Service Identifier
RSU	Road Side Unit

4 Overview

4.1 Categories of requirements to support eV2X scenarios

Different V2X scenarios require the transport of V2X messages with different performance requirements for the 3GPP system. This Technical Specification specifies service requirements to enhance 3GPP support for V2X scenarios in the following five areas:

- General Aspects: interworking, communication-related requirements valid for all V2X scenarios
- Vehicles Platooning
- Advanced Driving
- Extended Sensors
- Remote Driving

Vehicles Platooning enables the vehicles to dynamically form a group travelling together. All the vehicles in the platoon receive periodic data from the leading vehicle, in order to carry on platoon operations. This information allows the distance between vehicles to become extremely small, i.e., the gap distance translated to time can be very low (sub second). Platooning applications may allow the vehicles following to be autonomously driven.

Advanced Driving enables semi-automated or fully-automated driving. Longer inter-vehicle distance is assumed. Each vehicle and/or RSU shares data obtained from its local sensors with vehicles in proximity, thus allowing vehicles to coordinate their trajectories or maneuvers. In addition, each vehicle shares its driving intention with vehicles in proximity. The benefits of this use case group are safer traveling, collision avoidance, and improved traffic efficiency.

Extended Sensors enables the exchange of raw or processed data gathered through local sensors or live video data among vehicles, RSUs, devices of pedestrians and V2X application servers. The vehicles can enhance the perception of their environment beyond what their own sensors can detect and have a more holistic view of the local situation.

Remote Driving enables a remote driver or a V2X application to operate a remote vehicle for those passengers who cannot drive themselves or a remote vehicle located in dangerous environments. For a case where variation is limited and routes are predictable, such as public transportation, driving based on cloud computing can be used. In addition, access to cloud-based back-end service platform can be considered for this use case group.

4.2 Level of Automation

A relevant aspect of advanced V2X applications is the Level of Automation (LoA), which reflects the functional aspects of the technology and affects the system performance requirements. In accordance with the levels from SAE [4], the LoA are: 0 – No Automation, 1 – Driver Assistance, 2 – Partial Automation, 3 – Conditional Automation, 4 – High Automation, 5 – Full Automation.

A distinction is drawn between lower levels and higher levels based on whether the human operator or the automated system is primarily responsible for monitoring the driving environment.

The 3GPP system provides the performances expected for all levels of automation

5 Requirements

5.1 General Requirements

[R.5.1-001] The 3GPP system shall be able to control the communication range for a message based on the characteristic of the messages transmitted by a UE supporting V2X application.

[R.5.1-002] The 3GPP system shall be able to optimize the communication between UEs supporting V2X application belonging to the same group and in proximity.

[R.5.1-003] The 3GPP system shall be able to support the message transfer for group management operations as requested by the application layer.

NOTE 1: The determination of group membership may be done at the upper layers and/or lower layers (application and/or Layer 2).

[R.5.1-004] The 3GPP system shall be able to support message transfer among a group of UEs supporting V2X application.

[R.5.1-005] The 3GPP system shall be able to support message transfer between two UEs belonging to the same group of UEs supporting V2X application.

[R.5.1-006] The 3GPP system shall be able to support confidentiality and integrity of message transfer among a group of UEs supporting V2X application.

[R.5.1-007] The 3GPP system shall support relative lateral position accuracy of 0.1 m between UEs supporting V2X application.

[R.5.1-008] The 3GPP system shall support high connection density for congested traffic.

NOTE 2: Example estimate is for worst case US Freeway scenario that does not include arterial roads (i.e. onramps): 5 lanes in each direction or 10 lanes total per highway, for up to 3 highways intersecting = 3,100 to 4,300 cars per square kilometer

[R.5.1-009] The 3GPP system shall support efficient coordination of radio resources used for transport of messages to maximize the utilization of the available spectrum and to ensure the required reliability.

[R.5.1-010] The 3GPP system shall be able to control the UL and DL reliability of transport of V2X communications, depending on the requirement of V2X application

[R.5.1-011] Impact to E-UTRA(N) by UE supporting only NR based V2X communication shall be minimized.

[R.5.1-012] Impact to NR by UE supporting only E-UTRA based V2X communication shall be minimized.

[R.5.1-013] The 3GPP system shall be able to support message transfer between UEs or between a UE and a UE-type RSU, regardless of whether or not they are subscribers of the same PLMN supporting V2X communications. In case they are subscribers to different PLMNs, there shall be no service degradation of the message transfer.

[R.5.1-014] The 3GPP system shall enable discovery and communication between UEs supporting the same V2X application.

[R.5.1-015] The 3GPP system shall be able to support the operators to select which 3GPP RAT to use for a V2X application.

NOTE 3: Different V2X applications can be identified by use of different ITS-AID or PSID.

[R.5.1-016] The 3GPP system shall enable a UE supporting a V2X application to obtain network access via another UE supporting V2X application.

[R.5.1-017] The 3GPP system shall enable a UE supporting a V2X application to discover another UE supporting V2X application that can offer access to the network.

[R.5.1-018] The 3GPP system shall support switching between direct 3GPP connection and indirect 3GPP connection via a UE supporting a V2X application, for a UE supporting a V2X application.

[R.5.1-019] The 3GPP system should be able to support confidentiality and integrity of message transfer between a UE supporting a V2X application and network, when the UE is using an indirect 3GPP connection.

[R.5.1-020] The 3GPP system shall allow UEs supporting V2X application to use NR for direct communication when the UEs are not served by a RAN using NR.

[R.5.1-021] The 3GPP system shall allow UEs supporting V2X application to use E-UTRA for direct communication when the UEs are not served by a RAN using E-UTRA.

[R.5.1-022] An RSU shall be able to communicate with up to 200 UEs supporting a V2X application.

NOTE 4: This requirement specifies the number of UEs that RSU should be capable of handling. The requirement is not applied to the number of UE in a platoon.

NOTE 5: This requirement is not applied to UE-type RSU.

[R.5.1-023] The 3GPP system shall be able to support confidentiality and integrity of message transfer between a UE supporting V2X application and a V2X application server.

[R.5.1-024] The 3GPP system shall provide a mechanism to provide addressing information (e.g. IP address or FQDN) of V2X application server(s) to the UEs supporting V2X applications.

5.2 Requirements to support Vehicles Platooning

[R.5.2-001] The 3GPP system shall be able to support up to 5 UEs for a group of UEs supporting V2X application.

[R.5.2-002] For Vehicle Platooning, the 3GPP system shall be able to support reliable V2V communications between a specific UE supporting V2X applications and up to 19 other UEs supporting V2X applications.

NOTE 1: For group of heavy goods vehicle platooning, the number of UEs in a platoon can be smaller, due to communication range, the length of truck, inter-truck distance, etc.

[R.5.2-003] The 3GPP system shall support relative longitudinal position accuracy of less than 0.5 m for UEs supporting V2X application for platooning in proximity.