SURFACE VEHICLE INFORMATION REPORT

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Analysis of Network V2X-Based Services and Opportunities for Standardization

RATIONALE

There is an increasing need to provide various types of V2X applications for the safety of road users and traffic efficiency. Using mobile networks is one of the connectivity methods that can enable V2X applications. The focus of this report is the characteristics of mobile networks and the factors that should be considered for supporting corresponding network V2X-based services. It is intended to serve as a reference for future standards that define requirements for network V2X data exchange protocols and corresponding performance requirements.

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1. SCOPE

This report analyzes the characteristics of mobile network communication and highlights the technical aspects of using mobile networks to implement V2X applications. This report provides a high-level analysis of architecture, protocols, and performance and is intended to support future implementation guidance and standardization for providing V2X services over mobile networks, also referred to as network V2X.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (U.S. and Canada only) or +1 724-776-4970 (outside U.S. and Canada), www.sae.org.

SAE J2735 V2X Communications Message Set Dictionary

SAE J2945/1 On-Board System Requirements for V2V Safety Communications

2.1.2 Other Publications

5GAA Vehicle-to-Network-to-Everything (V2N2X) Communications: Architecture, Solution Blueprint, and Use Case Implementation Examples (May 2024). Available at V2N2X Communications: Architecture, Solution Blueprint, and Use Case Examples.

5GAA Road Traffic Operation in a Digital Age: A Holistic Cross-Stakeholder Approach (January 2024). Available at 5GAA White Paper: Road Traffic Operation in a Digital Age.

3GPP TS 22.1853GPP. Service requirements for V2X services; Stage 1. Technical Specification 3GPP TS 22.185, Release 14 and later. ETSI TS 122 185 V15.0.0 (2018-07). Available at https://www.etsi.org/deliver/etsi_ts/122100_122199/122185/15.00.00_60/ts_122185v150000p.pdf.

3GPP TS 22.1863GPP. Service requirements for enhanced V2X scenarios; Stage 1. Technical Specification 3GPP TS 22.186, Release 16 and later. ETSI TS 122 186 V16.2.0 (2020-11). Available at https://www.etsi.org/deliver/etsi_ts/122100_122199/122186/16.02.00_60/ts_122186v160200p.pdf.

3. DEFINITIONS

For the purposes of this standard, the definitions, abbreviations, and acronyms found in SAE J2735 also apply. In the case of conflict, the following additional definitions, abbreviations, and acronyms supersede those found in SAE J2735.

DIRECT V2X: A vehicle-to-everything interface used for localized data exchange directly between RSUs and OBUs and between OBUs. This interface is traditionally known to V2X stakeholders as a dedicated short-range interface.

NETWORK V2X: A vehicle-to-everything interface that uses IP-based protocols exclusively within cellular/mobile networks to reach an application host. This application host can be anywhere in the network or even an OBU. It is also known as V2N2X (vehicle-to-network-to-everything). This host is also referred to as a network access device (NAD) interface.

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4. ABBREVIATIONS

The additional abbreviations and acronyms cited below are terms related to this standard (and of the other companion volumes and guides), unless specifically cited otherwise.

AMQP	advanced message queuing protocol
DSRC	dedicated short-range communications
LTE-V2X	LTE vehicle-to-everything
MEC	multi-access edge computing
MNO	mobile network operator
MQTT	message queuing telemetry transport
NAD	network access device
OBU	onboard unit
RSU	roadside unit
V2N2X	vehicle-to-network-to-everything
V2V	vehicle-to-vehicle
V2X	vehicle-to-everything

5. ANALYSIS OF THE MOBILE NETWORK SUPPORTING V2X APPLICATIONS

5.1 V2X Connectivity

Vehicle-to-everything (V2X) describes wireless communication, i.e., connectivity, between a vehicle and an entity that exchanges data with the vehicle. V2X also enables the collection of information that cannot be obtained with autonomous sensors. For example:

- Enabling situation awareness beyond line-of-sight
- Less impacted by environmental factors, e.g., weather, light, etc.
- Sharing information in advance such as the maneuver intention, etc.

V2X connectivity enables sharing of information among vehicles, road users, and infrastructure to improve road safety and traffic efficiency. V2X connectivity has traditionally focused on direct V2X, but mobile networks can also be used to provide V2X connectivity as summarized in the following subsections. Hybrid approaches that use both direct and network V2X can also be considered.

5.2 Challenges for Network V2X

The following subsections introduce the technical concerns for network V2X-based services.

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