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Road vehicles ~~— Electromagnetic —~~ **Electrical** disturbances from narrowband radiated electromagnetic energy ~~—~~ **Radiated immunity for V2X**

Véhicules routiers ~~—~~ Perturbations électriques dues à l'énergie électromagnétique rayonnée ~~à~~**en** bande étroite ~~—~~ Immunité rayonnée pour V2X

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*A model manuscript of a draft International Standard (known as "The Rice Model") is available at*

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This document was prepared by Technical Committee ISO/TC 22, Road vehicles, Subcommittee SC 32, Electromagnetic and electronic components and general system aspects.

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## Introduction

V2X (Vehicle-to-Everything), including DSRC (Dedicated Short-Range Communication) and C-V2X (Cellular Vehicle-to-Everything), is one of the most popular automated driving technologies applied in ~~the vehicle~~vehicles.

Immunity of components and vehicles equipped with V2X communication is very important, which can help to avoid unreasonable degradation of automated driving from electromagnetic interference. For the test purpose, it is very difficult to simulate V2X operation during the immunity test.

The purpose of this document is to describe the background of V2X operating ~~condition~~conditions and information on the V2X simulation in the laboratory during the immunity test.

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# Road vehicles — ~~Electromagnetic~~ — ~~Electrical~~ disturbances from narrowband radiated electromagnetic energy — Radiated immunity for V2X

## 1 Scope

This document describes the introduction of radiated immunity testing for the components and vehicles equipped with V2X communications. The link communication connection and V2X scenario simulation are considered to make the V2X functions and their communications operate normally during the immunity testing. Examples of monitoring are also discussed to show the electromagnetic interference reactions of the device with V2X under test. In addition, test hints are described to provide information on radiated immunity for V2X. The technical ~~specification is~~specifications are not in the scope of this document.

## 2 Normative references

There are no normative references in this document.

## 3 Terms ~~and~~, definitions and abbreviated terms

### 3.1 General

~~For the purposes of this document, the following~~No terms and definitions ~~apply~~are listed in this document.

ISO and IEC maintain ~~terminological~~terminology databases for use in standardization at the following addresses:

- ~~=~~ISO Online browsing platform: available at <https://www.iso.org/obp>~~https://www.iso.org/obp~~
- ~~=~~IEC Electropedia: available at <https://www.electropedia.org/>

### 3.3 Abbreviations

### 3.2 Abbreviated terms

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

~~BSM~~ — Basic Safety Message

~~BSS~~ —

~~CAL~~ — Communication Adaptation Layer

~~CALM~~ —

~~CAM~~ — Cooperative Awareness Message

~~C-V2X~~ — Cellular Vehicle-to-Everything

~~DCC~~ — Distributed Congestion Control

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- DUT** — **Device Under Test**
- DSRC** — **Dedicated Short Range Communication**
- EEBL** — **Emergency Electronic Brake Lights**
- FCW** — **Forward Collision Warning**
- FEC** — **Forward Error Correction**
- GNSS** — **Global Navigation Satellite System**
- HV** — **Host Vehicle**
- IMA** — **Intersection Movement Assist**
- ITS** — **Intelligent Transport System**
- LCW** — **Lane Change Warning**
- LTA** — **Left Turn Assistance**
- LTE** — **Long Term Evolution**
- MAE** — **Management Adaptation Entity**
- MIIT** — **Ministry of Industry and Information Technology**
- NCAP** — **New Car Assessment Program**
- OBU** — **On Board Unit**
- PC5** — **ProSe Communication reference point 5**
- PER** — **Packet Error Ratio**
- RAN** — **Radio Access Network**
- RSSI** — **Received Signal Strength Indicator**
- RSU** — **Road Side Unit**
- RV** — **Remote Vehicle**

~~RWW~~ ~~Road Works Warning~~

~~WAVE~~ ~~Wireless Access in Vehicular Environments~~

~~V2X~~ ~~Vehicle to Everything~~

~~V2V~~ ~~Vehicle to Vehicle~~

~~V2I~~ ~~Vehicle to Infrastructure~~

~~V2P~~ ~~Vehicle to Pedestrian~~

~~V2N~~ ~~Vehicle to Network~~

ALSE Absorber Lined Shielded Enclosure

BSM Basic Safety Message

BSS Basic Service Set

CAL Communication Adaptation Layer

CALM Communications Access for Land Mobiles

CAM Cooperative Awareness Message

C-V2X Cellular Vehicle-to-Everything

C2C Car-to-Car

C2I Car-to-Infrastructure

C2P Car-to-Pedestrian

C2N Car-to-Network

DCC Distributed Congestion Control

DUT Device Under Test

DSRC Dedicated Short-Range Communication

EEBL Emergency Electronic Brake Lights

FCW Forward Collision Warning

FEC Forward Error Correction

GNSS Global Navigation Satellite System

HV Host Vehicle

IMA Intersection Movement Assist

ITS Intelligent Transport System

LCW Lane Change Warning

LTA Left Turn Assistance

LTE Long Term Evolution

MAE Management Adaptation Entity

MIIT Ministry of Industry and Information Technology

NCAP New Car Assessment Program

<u>OBU</u>	<u>On-Board Unit</u>
<u>PC5</u>	<u>ProSe Communication reference point 5</u>
<u>PER</u>	<u>Packet Error Ratio</u>
<u>RAN</u>	<u>Radio Access Network</u>
<u>RSSI</u>	<u>Received Signal Strength Indicator</u>
<u>RSU</u>	<u>Road-Side Unit</u>
<u>RV</u>	<u>Remote Vehicle</u>
<u>RWW</u>	<u>Road Works Warning</u>
<u>WAVE</u>	<u>Wireless Access in Vehicular Environments</u>
<u>V2X</u>	<u>Vehicle-to-Everything</u>
<u>V2V</u>	<u>Vehicle-to-Vehicle</u>
<u>V2I</u>	<u>Vehicle-to-Infrastructure</u>
<u>V2P</u>	<u>Vehicle-to-Pedestrian</u>
<u>V2N</u>	<u>Vehicle-to-Network</u>

4 Overview of V2X

4.1 V2X description

V2X can be considered a wireless environment sensing sensor, which allows vehicles to share information through communication channels. It can detect hidden threats and expand the sensing range of automated vehicle. There are many advanced applications such as vehicle platooning, remote driving, and cooperative automated valet parking system where V2X communication is essential. V2X has the potential to inform the ego-vehicle about the status of a traffic light or other vehicles, weather conditions, crashes on the road and construction on the road, especially during severe weather conditions and in complex traffic scenarios. V2X contains V2V, V2I, V2P and V2N as shown in the following.

- ~~Vehiclevehicle~~ to ~~Vehiclevehicle~~ (V2V) ~~Communicationscommunications~~ (same as ~~Carcar-to-Carcar~~ (C2C))):
- ~~Vehiclevehicle~~ to ~~Infrastructureinfrastructure~~ (V2I) ~~Communicationscommunications~~ (same as ~~Carcar-to-Infrastructureinfrastructure~~ (C2I))):
- ~~Vehiclevehicle~~ to ~~Pedestrianpedestrian~~ (V2P) ~~Communicationscommunications~~ (same as ~~Carcar-to-Pedestrianpedestrian~~ (C2P))):
- ~~Vehiclevehicle~~ to ~~Networknetwork~~ (V2N) ~~Communicationscommunications~~ (same as ~~Carcar-to-Networknetwork~~ (C2N))):

V2X contains positioning technology and wireless communication technology. Two major wireless communication technologies can support V2X applications, namely DSRC and C-V2X. DSRC was published by the 802.11p group of IEEE in 2010. C-V2X was first introduced at World Telecommunication Day Conference in 2013 and published in 3GPP in 2017.

C-V2X communications contain three communication interfaces:

- PC5 communications interface;
- Cellular communications interface (LTE, NR).

Examples of general structure description of V2X On-board Unit/on-board unit are shown in Figure 1.

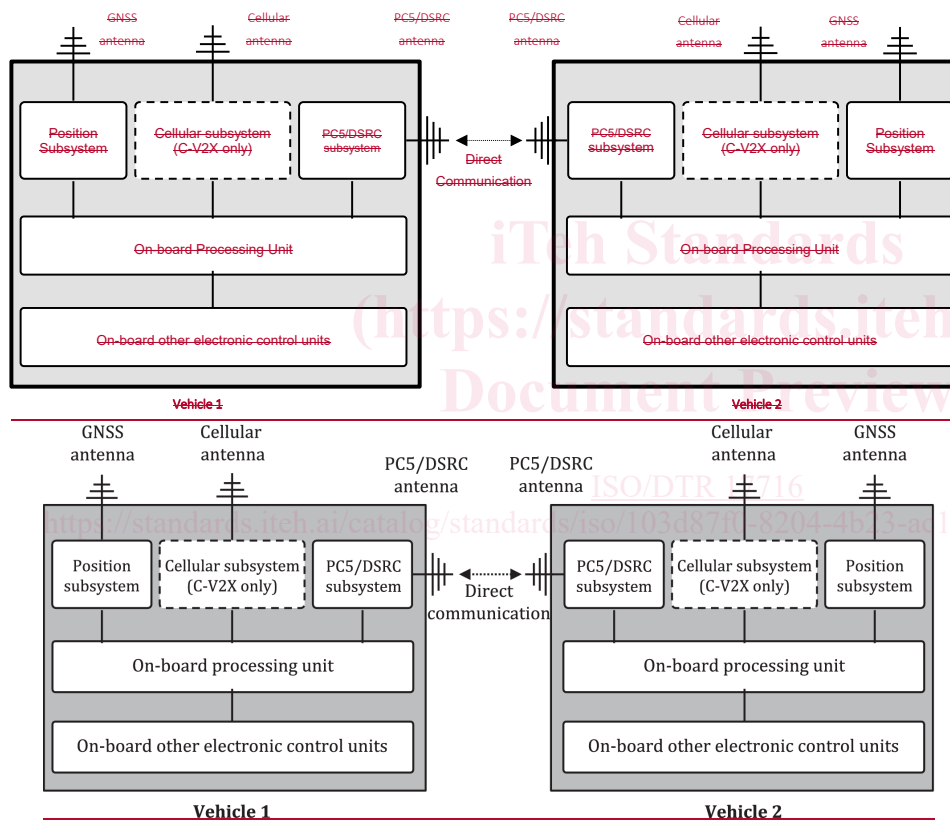


Figure 1 — General structure description of V2X On-board Unit/on-board unit

List of reference documents:

- IEEE 802.11p (2010): DSRC technical standard
- IEEE 802.11p (2010): IEEE Standard for Information technology-- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments

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— 3GPP TR 37.985 V16.0.0 (2020-06) “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Overall description of Radio Access Network (RAN) aspects for Vehicle-to-everything (V2X) based on LTE and NR (Release 16)”

4.2 Industry trends

V2X has been equipped in lots of production cars (see Table 1).

Table 1 — V2X in production cars

NO.	Vehicle model	Ford	GAC GROUP	Buick	FAW	SAIC	Audi	GWM
		Edge Plus	AION V	GL8 Avenir	E-HS9	Marvel R	A7L	WEY
1	Forward collision warning				√			√
2	Intersection collision warning		√	√	√	√		√
3	Left turn assist					√		√
4	Blind spot warning/ lane change warning				√			√
5	Do not pass warning		√					√
6	Emergency brake warning			√	√			√
7	Abnormal vehicle warning			√				√
8	Hazardous location warning			√		√		√
9	Control loss warning			√				√
10	Speed limit warning			√	√	√		√
11	Red light violation warning	√		√		√	√	√
12	Vulnerable road user collision warning		√			√	√	√