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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

~~DTR~~FDIS stage

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, ~~—~~ ~~*Electromagnetic*~~*Electrical 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.

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 isspecifications 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 followingNo terms and definitions applyare listed in this document.

ISO and IEC maintain terminologicalterminology databases for use in standardization at the following addresses:

— =ISO Online browsing platform: available at https://www.iso.org/obphttps://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

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

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

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.

— ~~Vehicle~~vehicle to ~~Vehicle~~vehicle (V2V) ~~Communications~~communications (same as ~~Car~~car-to-~~Car~~car (C2C~~)~~)):

— ~~Vehicle~~vehicle to ~~Infrastructure~~infrastructure (V2I) ~~Communications~~communications (same as ~~Car~~car-to-~~Infrastructure~~infrastructure (C2I~~)~~)):

— ~~Vehicle~~vehicle to ~~Pedestrian~~pedestrian (V2P) ~~Communications~~communications (same as ~~Car~~car-to-~~Pedestrian~~pedestrian (C2P~~)~~)):

— ~~Vehicle~~vehicle to ~~Network~~network (V2N) ~~Communications~~communications (same as ~~Car~~car-to-~~Network~~network (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~~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.~~.

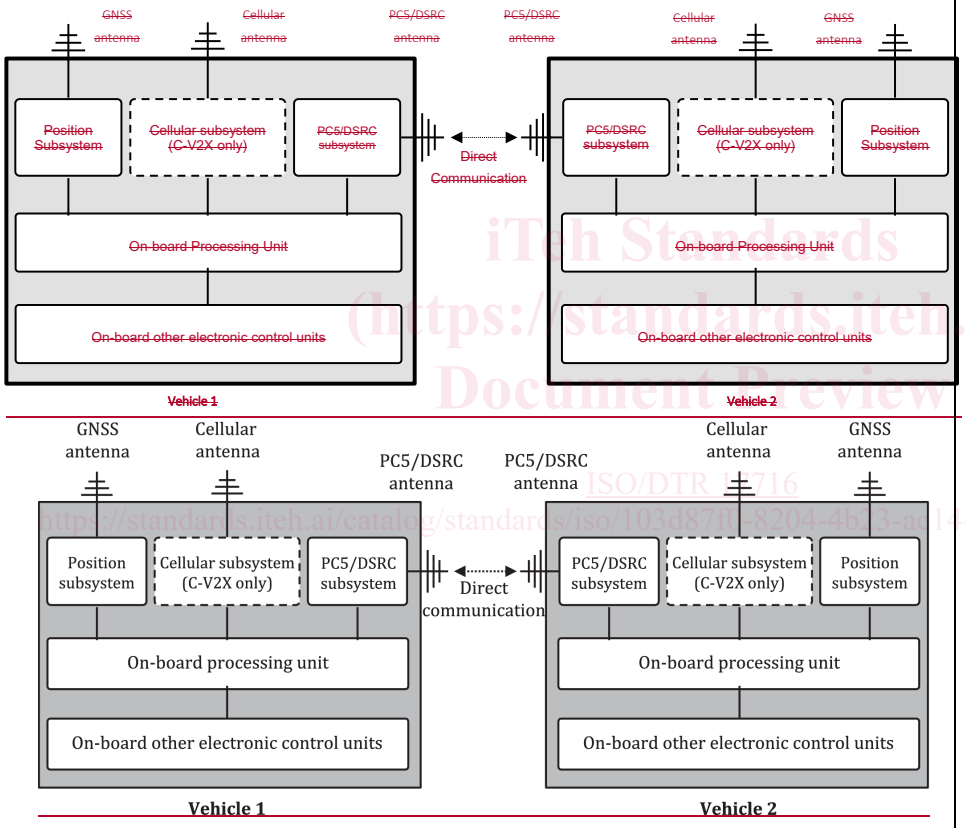

Figure 1 — General structure description of V2X ~~On-Board Unit~~on-board unit

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

— 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 1Table 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		√			√	√	√