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Electronic fee collection — Measurement of interferences on tolling and tachograph devices from radio local area network devices operating in the 5,8 GHz frequency range — Test suite structure and test purposes

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English Version

Electronic fee collection - Measurement of interferences on tolling and tachograph devices from radio local area network devices operating in the 5,8 GHz frequency range - Test suite structure and test purposes

Perception de télépéage - Mesure des interférences sur des dispositifs de péage et de tachygraphe provenant de dispositifs de réseaux locaux sans fil fonctionnant dans la gamme de fréquences de 5,8 GHz - Structure de la suite d'essais et objectifs des essais

Elektronische Gebührenerhebung - Messungen von Interferenzen an Maut- und Tachografgeräten von drahtlosen Nahbereichsnetzwerk-Geräten im Frequenzbereich von 5,8 Ghz - Struktur der Prüffolge und Prüfabsicht

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European foreword

This document (CEN/TS 18078:2024) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

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Introduction

It is well known that the dedicated short-range communication (DSRC) band of frequencies around 5,8 GHz used in Europe and Japan for tolling is increasingly subject to interferences by other radio frequency (RF) technologies. In the past, extensive analysis, theoretical studies, and tests of real systems have been conducted that led to the specification of measures to prevent detrimental interferences between tolling devices and ITS devices operating in the 5,9 GHz band (ETSI ITS-G5) and ensure their co-existence. The recent development in radio LAN (RLAN) technologies have brought portable RLAN devices operating in the 5,8 GHz band, so that harmful interferences with tolling devices are to be expected. It is to be noted that other important European services operating in the same band other than tolling are impacted, such as the regulated European smart tachograph, which exchanges data with roadside units using CEN DSRC technology and a protocol similar to that used for tolling.

Mitigation techniques to reduce or eliminate harmful interferences can be determined based on analytical models. However, the characteristics of radio transmissions at this range of frequencies are such that it is impossible to consider all factors that impact interference phenomena. Theoretical assumptions need to be verified by field tests.

It is essential that such tests, which may lead to regulated mitigation techniques, are standardized together with the physical setup in which the tests are performed.

The present document specifies a standardized test setup and a test suite structure and test purposes (TSS and TP) to measure interferences on incumbent road tolling and tachograph devices from RLANs operating in the 5,8 GHz range.

The tests are designed to be run in a controlled environment (anechoic chamber) in order to minimize other factors that may have an impact on measurements with the DSRC communication. Among these factors, but not limited to the following list, are:

- weather condition: influence of moisture, rain and snow;
- (wrong) mounting of a device (inside a vehicle): on the side window, built into the dashboard, behind or under the seat, …;
- damaged devices: defect due to incorrect handling of the equipment (falling, …);
- defect beacon/antenna;
- use of obstructive materials, like (metal) holders (or other mounting aids) and cables;
- shielding (in partial or full) caused by the composition of the windscreen;
- positioning of other components in and around the vehicle, including rear view mirrors, exterior mirrors, vehicle seats and others that can cause deviations in (the quality of) the signal, even when a device has been correctly installed;
- sun visor, typically mounted on trucks, can block the signal if the OBE is mounted behind it (partial or full);
- windscreen wipers (covering the equipment, also related to wrong mounting position);
- glass constructed for windscreen heating;
- armoured vehicles;
- safety glass (in heavy duty or armoured vehicles);

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- use of multiple OBE devices inside the same vehicle;
- stone chipping protection;
- use of other equipment or cabling, around the device;
- angle of the device: the angle can be different among types of vehicles, but angle can also be affected by an OBE lying on a dashboard;
- distance between the device's antenna and the windscreen.

Additionally, possible interferences that are caused by communications with devices other than RLAN are also out of the scope of this document, such as Vehicle to Vehicle (V2V) communication or Vehicle to Infrastructure (V2I) communication.

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1 Scope

This document specifies the set-up of a testing system and the test suite structure and test purposes, i.e. tests to be used to assess the level of interference from RLAN devices operating in the 5,8 GHz range on tolling and tachograph devices operating in the same frequency range.

To obtain generalized results that can subsequently be used to design appropriate mitigation techniques, the test environment and the test cases are designed to:

1. acquire a large number of transactions on devices of different makes and characteristics;
2. ensure anonymity of results.

The test results ensure calculation of averages as well as standard deviations.

The tests specified in this document are for the sole purpose of investigating RLAN interference over DSRC communications. Other factors that can impact the performance of DSRC and also the level of interference in a test scenario are not subject to test specifications and out of the scope of this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

— IEC Electropedia: available at https://www.electropedia.org/

3.1
modulation and coding scheme
MCS
specification of the high-throughput (HT) physical layer (PHY) parameters that consists of modulation order (e.g. BPSK, QPSK, 16-QAM, 64-QAM) and forward error correction (FEC) coding rate (e.g. ½, ⅔, ¾, ⅚)

[SOURCE: IEEE 802.11-2012. definition: modulation and coding scheme]

3.2
radio frequency interference
RFI
effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy

[SOURCE: ITU Radio Regulations, Section VII. Frequency sharing – Article 1.166, definition: interference]

3.3
interferer
device that causes RFI (3.2)

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3.4
victim
device whose operation is negatively affected by RFI (3.2)

3.5
duty cycle
fraction of one period in which a signal or system is active

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

16-QAM	16 quadrature amplitude modulation
64-QAM	64 quadrature amplitude modulation
ADU	application data unit
AINT	azimuth interferer
BPSK	binary phase shift keying
CS	carrier sense
dBm	decibels relative to a milliwatt
DSRC	dedicated short range communication
OBE	on-board equipment
EFC	electronic fee collection
EIRP	equivalent isotropically radiated power
FEC	forward error correction
HT	high throughput
LHCP	left hand circular polarisation
MCS	modulation and coding scheme
ms	millisecond
OFDM	orthogonal frequency-division multiplexing
OFDMA	orthogonal frequency-division multiple access
PC	personal computer
PHY	physical layer
QPSK	quadrature phase shift keying
REDCR	remote early detection communication reader
RLAN	radio local area network
RF	radio frequency
RFI	radio frequency interference
RSE	roadside equipment
RTM	remote tachograph monitoring

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SAC	shielded anechoic chamber
TC	toll charger
TPC	transmitter power control
TX	Transmitter
VU	vehicle unit
VU-OWS	vehicle unit onboard weighting system
VE-RTM	vehicle unit remote tachograph monitoring
VUPM	vehicle unit payload memory
VUSM	vehicle unit security module

5 Interference tests on couples of interacting devices

5.1 Generalities

5.1.1 Regulations

The European Commission has enacted a number of Directives and Regulations related to radio equipment. General requirements are set out in the Radio equipment directive (2014/53/EU). For RLAN and road tolling applications, specific EU legislation exists with corresponding CEPT deliverables.

CEPT regulation on RLAN in the 5 GHz frequency band is based on the following decision: ECC Decision (04)08 designates 5150-5350 MHz and 5470-5725 MHz for WAS/RLANs in the 5 GHz range. Corresponding EU legislation was given in Decision 2005/513/EC complemented by EC Decision 2007/90/EC. CEPT Report 79 in response to the EC Mandate on RLAN at 5 GHz investigated possibilities for the usage of WAS/RLAN on board vehicles, aircraft, road vehicles. Subsequently, ECC Decision (04)08 has been amended, and the new Commission Implementing Decision (EU) 2022/17 has been published.

CEPT conducted several compatibility studies that investigate sharing conditions and interference mitigation. CEPT Report 79 and ECC Report 330 (chapter 4) contain an overview of the studies conducted. CEPT performed compatibility studies related to RLANs in the 5725-5925 MHz band in ECC Report 244, showing a "*need for significant separation distances*" for the compatibility of RLAN with road tolling in the band 5795-5815 MHz. As of today, the use of the 5725-5850 MHz band by WAS/RLAN equipment is not harmonized under CEPT regulation nor under EU regulation. However, there may be national regulations and "RLAN technology" can operate under short range device (SRD) regulation. The usage under SRD regulation in cars has been studied in ECC Report 277.

CEPT regulation introduced road tolling in ECC Decision (02)02 on the coordinated introduction of Road Transport Telematic Systems, identifying the frequencies for road tolling applications in the band 5 795 MHz to 5 815 MHz. It was replaced by ECC Decision (02)01 and later repealed by ECC Decision (12)04 when applicable EU legislation (Directive 2004/52/EC) was available. The name changed to Road Transport and Traffic Telematic (RTTT) and later to "Transport and Traffic Telematics" (TTT). RTTT was included in the EC Decision on short range devices (2006/771/EC) within its 5th update. Commission Implementing Decision (EU) 2019/1345 on the usage of short range devices sets the harmonized technical conditions for TTT within 5 795 MHz to 5 815 MHz for "road tolling applications and smart tachograph, weight and dimension applications".

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