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Test specifications for the mitigation techniques to avoid interference between Cooperative ITS-G5 and TTT DSRC;
Part 2: Test Suite Structure and Test Purposes (TSS & TP)

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 2 of a multi-part deliverable covering the test specifications for the mitigation techniques to avoid interference between Cooperative ITS-G5 and TTT DSRC, as identified below:

Part 1: "Protocol Implementation Conformance Statement (PICS)";

Part 2: "Test Suite Structure and Test Purposes (TSS & TP)";

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).

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1 Scope

The present document provides the Test Suite Structure and Test Purposes (TSS&TP) for the test specifications for the methods to ensure coexistence of cooperative ITS-G5 with TTT DSRC as specified in ETSI TS 102 792 [4] and ETSI EN 302 663 [1] in compliance with the relevant requirements and in accordance with the relevant guidance given in ISO/IEC 9646-7 [i.4] and ETSI ETS 300 406 [i.2].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 302 663: "Intelligent Transport Systems (ITS); ITS-G5 Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[2] ETSI TS 102 916-1: "Intelligent Transport Systems (ITS); Test specifications for the methods to ensure coexistence of Cooperative ITS G5 with RTTT DSRC; Part 1: Protocol Implementation Conformance Statement (PICS)".

[3] ETSI EN 302 571 (V2.1.1): "Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[4] ETSI TS 102 792 (V1.2.1): "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range".

[5] ETSI EN 302 637-2 (V1.3.2): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[6] ETSI TS 102 894-2 (V1.2.1): "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Void.

[i.2] ETSI ETS 300 406: "Methods for testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

[i.3] ISO/IEC 9646-1: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

[i.4] ISO/IEC 9646-7: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 7: Implementation Conformance Statements".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI TS 102 792 [4], ETSI EN 302 663 [1] and the following apply:

Abstract Test Method (ATM): Refer to ISO/IEC 9646-1 [i.3].

Abstract Test Suite (ATS): Refer to ISO/IEC 9646-1 [i.3].

Implementation Under Test (IUT): Refer to ISO/IEC 9646-1 [i.3].

Test Purpose (TP): Refer to ISO/IEC 9646-1 [i.3].

3.2 Symbols

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

CenDsrcTollingZone	data field of vehicle CAM containing protected zone information
ProtectedCommunicationZone	data field of roadside unit CAM containing protected zone information
protectedZoneType	distinguishes between temporary and non-temporary protected zone information
T_{off}	time in between two transmissions
T_{on}	duration of a transmitted data packet

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 792 [4], ETSI EN 302 663 [1] and the following apply:

ATS	Abstract Test Suit
CAM	Cooperative Awareness Message
CEN	Comité Européen de Normalisation
DSRC	Dedicated Short Range Communication
GPS	Global Positioning System
ICS	Implementation Conformance Statement
ITS	Intelligent Transport System
ITS-G5	Acronym for the 5,9 GHz vehicular ad-hoc network
ITS-S	ITS Station
IUT	Implementation Under Test
OBU	On Board Unit
PICS	Protocol Implementation Conformance Statement
RF	Radio Frequency
SUT	System under Test
TP	Test Purpose
TSS	Test Suite Structure
TTT	Transport and Traffic Telematics
TX	Transmit

4 Test configurations

4.1 Overview

Test purposes of the present document address the mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (TTT DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range.

The mitigation techniques are specified in ETSI TS 102 792 [4]. Mobile ITS-S can either trigger the mitigation method when close to a TTT DSRC toll station, or operate always in coexistence mode. Depending on the distance to the next TTT DSRC toll station, fixed ITS-S can either operate always in normal mode, or they shall always operate in coexistence mode.

When operating in coexistence mode, the TX power level and/or the TX timing (duty cycle) of the ITS-S are restricted. The TX power level restriction depends on the distance to the tolling station, and the duty cycle restriction depends on the number ITS-S surrounding the toll station. Both methods can be combined. Four coexistence modes (A, B, C, and D) are specified in ETSI TS 102 792 [4] to simplify the choice of appropriate implementation criteria in terms of complexity and performance. For fixed ITS-S an additional mitigation method is specified in ETSI TS 102 792 [4] that is based on time synchronization with the tolling station nearby.

From this, the following test purposes can be derived:

- Triggering by detection of a TTT DSRC RF signal
- Triggering by a geolocation database
- Triggering by reception of a geolocation
- Mitigation by TX power reduction
- Mitigation by duty cycle restriction
- Mitigation by time synchronization with the tolling station

The following clauses specify the test configurations necessary to assess the abovementioned test purposes.

4.2 TTT DSRC RF detector test configuration

The test configuration and test description for the TTT DSRC RF detector test is specified in clause 5.3.10.3.3 of ETSI EN 302 571 V2.1.1 [3].

4.3 Geolocation simulator test configuration

For the test purposes that assess the correct detection of a tolling station by its geolocation, a GPS simulator is necessary. The GPS simulator is connected to the GPS antenna connector of the SUT and simulates the signals of GPS satellites characteristic for a certain geolocation. Alternatively the geolocation can be transferred to the SUT via a test interface.

4.4 CAM coexistence message test configuration

ETSI EN 302 637-2 [5] and ETSI TS 102 894-2 [6] specify the CAM data fields *CenDsrcTollingZone* for vehicle ITS-S (ICS 17) and *ProtectedCommunicationZone* for ITS-S of type road side unit (ICS 16), to disseminate the protected zone information. For a roadside unit the data element *protectedZoneType* is used to distinguish between a temporary protected zone position (*protectedZoneType* 1) and a protected zone centre position list (*protectedZoneType* 0).

For the test purposes that assess the correct handling of the CAM data fields *CenDsrcTollingZone* and *ProtectedCommunicationZone*, a test system that can transmit a CAM containing one of these data fields shall be connected to the ITS-G5 antenna connector of the SUT.

4.5 TX power level test configuration

The test configuration and test description for the RF output power measurement is specified in clause 5.3.3 of ETSI EN 302 571 V2.1.1 [3].

4.6 Unwanted emission test configuration

The test configuration and test description for the RF unwanted emissions measurement is specified in clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3].

4.7 Duty cycle test configuration

The time T_{on} is defined as the duration of a transmitted data packet. The time T_{off} is the time in between two transmissions. T_{on} can be determined by measuring the time while the transmit power level is above an appropriate threshold, while T_{off} is the time during which the transmit power level is below this threshold.

The maximum time measurement deviation of the test system shall be better than ±100 µs.

4.8 Time synchronization test configuration

The test configuration for the time synchronization test consists of a tolling station that is synchronized with the SUT, so that the SUT is never transmitting when the toll system is transmitting or receiving. The transmission timing of the SUT can be assessed similar to the duty cycle test configuration specified in clause 4.7. The transmission timing of the tolling station can be either assessed by monitoring of the TX power level or by a test interface, since for the reception timing assessment anyhow a test interface is necessary.

5 Test Suite Structure (TSS)

5.1 General

5.1.1 Introduction

Test Purposes have been written for mitigation techniques to avoid interference between European Transport and Traffic Telematics Dedicated Short Range Communication (TTT DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range as defined in ETSI TS 102 792 [4] and ETSI EN 302 663 [1]. All test purposes in the present document assess mandatory functionality unless they have been marked with the keyword "OPTIONAL" at the beginning of the TP summary. The test purposes can only be performed when certain preconditions are met. These preconditions are listed in the TP summary tables.

The test purposes have been divided according to the functionalities into two groups:

- TP_MIT Mitigation methods
- TP_TRIG Trigger methods

5.1.2 TP naming convention

TPs are numbered, starting at 001, within each group. Groups are organized according to the TSS.

Table 1: TP identifier naming convention scheme

Identifier: **<TP>_<scope>_<iut>_<nnn>**				
<tp>	=	Test Purpose:	fixed to "TP"	
<scop>	=	group	MIT	Test of mitigation method
			TRIG	Test of coexistence mode triggering
<iut>	=	type of IUT:	VEHICLE	ITS-G5 vehicle station
			PERSON	Personal ITS-G5 device
			FIX	ITS-G5 roadside station
			MOBILE	ITS-G5 personal devices and ITS-G5 vehicle stations
			ALL	Any ITS-G5 station
<nn>	=	sequential number	(01 to 99)	

5.1.3 Test strategy

As the base standards ETSI TS 102 792 [4] and ETSI EN 302 663 [1] contain no explicit requirements for testing, the TPs were generated as a result of an analysis of the base standard and the PICS specification ETSI TS 102 916-1 [2].

Radio conformance tests specified in ETSI EN 302 571 [3] are included in the present document by reference.

The test descriptions are split into the assessment of mitigation methods (clause 5.2.1) and the assessment of the correct triggering of the mitigation methods for mobile ITS-S (clause 5.2.2). The triggering tests include the assessment of the detection and determination of the size of a protected zone. The mitigation methods are assessed by characterizing the transmit timing (e.g. duty cycle) and the spectral power density of the transmitted signal.

For mobile ITS-S the mitigation test method is an integral part of the triggering test. Only for fixed ITS-S and mobile ITS-S operating always in coexistence mode the mitigation test method shall be tested separately.

Clause 5.2.1.8 is only applicable to fixed ITS-S and deals with the special case of synchronizing it with a tolling station.

5.2 Test Purposes

5.2.0 Introduction

All PICS items referred to by their Implementation Conformance Statement (ICS) item number in this clause are as specified in ETSI TS 102 916-1 [2] unless indicated otherwise by another numbered reference.

5.2.1 Mitigation methods

5.2.1.1 Mitigation method overview

ETSI TS 102 792 [4] specifies four mitigation methods for mobile ITS-S denominated as coexistence mode A, B, C, and D. The equipment manufacturer shall declare in ETSI TS 102 916-1 [2] the supported coexistence mode(s). Depending on the declared coexistence mode, the following clauses outline different test setups and test sequences that are used by the mitigation triggering tests.

When the SUT is always operating in coexistence mode or for fixed ITS-S these test purposes shall be performed when applicable. Otherwise the applicable triggering test cases specified in clause 5.2.2 shall be performed.

5.2.1.2 Mitigation method prerequisites

For the mitigation method test purposes the SUT is assumed to be in a protected zone (see clause 5.1 and clause 5.2 in ETSI TS 102 792 V1.2.1 [4]).

When the SUT is always operating in coexistence mode (ICS 3) the SUT is assumed to be always in the centre of the protected zone.

When the SUT does use the default ITS radio parameters (ICS 13), the protected zone radius is 55 m, or when available the value from a related CAM or a data base entry. Otherwise the protected zone radius shall be determined as specified in clause 5.2.3 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.3 Coexistence mode A

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the support of coexistence mode A (ICS 8), then the test specification in this clause shall be applied when the preconditions are met.

Coexistence mode A is only applicable when the antenna mounting distance is at least 1,5 m away from the intended TTT DSRC OBU mounting position, or the field strength at this position does not exceed the threshold specified in clause 4.2 of ETSI TS 102 792 V1.2.1 [4] when the ITS station is transmitting with 10 dBm (ICS 20).

Identifier:	TP_MIT_ALL_01		
Summary:	Coexistence mode A		
Configuration:	Specified in clause 5.3.3 and clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3]. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).		
SUT	ITS-G5 station		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4] ETSI EN 302 571 V2.1.1 [3]		
Pre-test conditions:	Mandatory when ... • ... SUT supports coexistence mode A (ICS 8) and • ... at least one of the following conditions applies: ▪ A coexistence mode trigger event as specified in clause 5.2.2 was raised ▪ The SUT is a fixed ITS-S (ICS 16) ▪ The SUT is always operating in coexistence mode (ICS 3)		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	action	Measure the RF output power according to clause 5.3.3 of ETSI EN 302 571 V2.1.1 [3].
	3	action	Measure the unwanted emissions according to clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3].
	4	verify	The measured RF output power level and unwanted emissions shall meet the limits specified for coexistence mode A in table 3.5 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.4 Coexistence mode B

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the support of coexistence mode B (ICS 9), then the test specification in this clause shall be applied when the preconditions are met.

Identifier:	TP_MIT_ALL_02
Summary:	Coexistence mode B
Configuration:	Specified in clause 5.3.3 and clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3] and for the duty cycle test in clause 4.7 of the present document. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).
SUT	ITS-G5 station
Specification Reference:	ETSI TS 102 792 V1.2.1 [4] ETSI EN 302 571 V2.1.1 [3]
Pre-test conditions:	Mandatory when ... • ... SUT supports coexistence mode B (ICS 9) and • ... at least one of the following conditions applies: ▪ A coexistence mode trigger event as specified in clause 5.2.2 was raised ▪ The SUT is a fixed ITS-S (ICS 16) ▪ The SUT is always operating in coexistence mode (ICS 3)

Test Sequence:	Step	Type	Description
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	action	Measure the RF output power according to clause 5.3.3 of ETSI EN 302 571 V2.1.1 [3].
	3	action	Measure the unwanted emissions according to clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3].
	4	action	Measure T_{on} and T_{off}. When the SUT supports multichannel operation (ICS 15) the transmissions on all supported channels shall be taken into account for the determination of T_{on}.
	5	verify	The measured RF output power level, unwanted emissions and timing parameters shall meet the limits specified for coexistence mode B in table 3.5 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.5 Coexistence mode C

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the support of coexistence mode C (ICS 10), then the test specification in this clause shall be applied when the preconditions are met.

Identifier:	TP_MIT_ALL_03		
Summary:	Coexistence mode C		
Configuration:	Specified in clause 4.7. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).		
SUT	ITS-G5 station		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	Mandatory when ... • ... SUT supports coexistence mode C (ICS 10) and • ... at least one of the following conditions applies: ▪ A coexistence mode trigger event as specified in clause 5.2.2 was raised ▪ The SUT is a fixed ITS-S (ICS 16) ▪ The SUT is always operating in coexistence mode (ICS 3)		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	setup	Connect a test signal generator to the SUT that can simulate the CAM of up to twelve ITS stations within the assumed protected zone.
	3	action	Measure T_{on} and T_{off} for zero, six and twelve simulated surrounding ITS-S within the assumed protected zone. When the SUT supports multichannel operation (ICS 15) the transmissions on all supported channels shall be taken into account for the determination of T_{on}.
	4	verify	The measured timing parameters shall meet the limits specified for coexistence mode C in table 3.5 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.6 Coexistence mode D

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the support of coexistence mode D (ICS 11), then the test specification in this clause shall be applied when the preconditions are met.

Identifier:	TP_MIT_ALL_04		
Summary:	Coexistence mode D		
Configuration:	Specified in clause 4.7. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).		
SUT	ITS-G5 station		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	Mandatory when ... • ... SUT supports coexistence mode D (ICS 11) and • ... at least one of the following conditions applies: ▪ A coexistence mode trigger event as specified in clause 5.2.2 was raised ▪ The SUT is a fixed ITS-S (ICS 16) ▪ The SUT is always operating in coexistence mode (ICS 3)		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	setup	Connect a test signal generator to the SUT that can simulate the CAM of up to twelve ITS stations within the assumed protected zone.
	3	action	Measure T_{on} and T_{off} for zero, six and twelve simulated surrounding ITS-S within the assumed protected zone. When the SUT supports multichannel operation (ICS 15) the transmissions on all supported channels shall be taken into account for the determination of T_{on}.
	4	verify	The measured timing parameters shall meet the limits specified for coexistence mode D in table 3.5 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.7 Combined power reduction and duty cycle restriction

If the equipment manufacturer declared in ETSI TS 102 916-1 [2], the use of a power reduction and/or a duty cycle restriction (ICS 4, ICS 5, or ICS 6) and the support of an alternative mitigation method (ICS 12) not covered by mitigation mode A, B, C, or D, then the test specification in this clause shall be applied when the preconditions are met.

This can be the case when e.g. the SUT antenna mounting is below 2 m from ground (ICS 19 not supported).

Identifier:	TP_MIT_ALL_05
Summary:	Combined power reduction and duty cycle restriction
Configuration:	Specified in clause 5.3.3 and clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3] and for the duty cycle test in clause 4.7 of the present document. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).
SUT	ITS-G5 station
Specification Reference:	ETSI TS 102 792 V1.2.1 [4] ETSI EN 302 571 V2.1.1 [3]
Pre-test conditions:	Mandatory when ... • ... SUT supports an alternative mitigation method (ICS 12) based on combined power reduction and duty cycle restriction and • ... at least one of the following conditions applies: ▪ A coexistence mode trigger event as specified in clause 5.2.2 was raised ▪ The SUT is a fixed ITS-S (ICS 16) ▪ The SUT is always operating in coexistence mode (ICS 3)

Test Sequence:	Step	Type	Description
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	setup	Connect a test signal generator to the SUT that can simulate the CAM of up to twelve ITS stations within the assumed protected zone.
	3	action	Measure the RF output power according to clause 5.3.3 of ETSI EN 302 571 V2.1.1 [3], the unwanted emissions according to clause 5.3.4 of ETSI EN 302 571 V2.1.1[3], T_{on}, and T_{off} for zero, six and twelve simulated surrounding ITS-S within the assumed protected zone. When the SUT supports multichannel operation (ICS 15) the transmissions on all supported channels shall be taken into account for the determination of T_{on}.
	4	verify	The measured RF output power level, unwanted emissions and timing parameters shall meet the limits specified in ETSI TS 102 792 V1.2.1 [4]. The limits can be met by ... • ... placing the SUT antenna below 2 m from ground, or • ... reducing the TX power level, so that according to table 5.1 in ETSI TS 102 792 V1.2.1 [4] the protected zone radius gets smaller than the distance to the toll station, or • ... using a duty cycle restriction as specified by equation 5.1 or equation 5.2 in clause 5.4 in ETSI TS 102 792 V1.2.1 [4].

5.2.1.8 Synchronization of fixed ITS-S with a tolling station

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the use of a fixed ITS-G5 antenna (ICS 16) and the synchronization with a tolling station (ICS 7), then the test specification in this clause shall be applied when the preconditions are met.

Identifier:	TP_MIT_FIX_06		
Summary:	Fixed ITS-G5 station synchronized with a tolling station		
Configuration:	See clause 4.8		
SUT	Fixed ITS-G5 station (ICS 16)		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	• SUT supports synchronization with a tolling station (ICS 7)		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	action	Set the SUT in a test mode, where it sends messages with an average message rate of 10 Hz. Set the tolling system into a test mode, so that it continuously performs tolling transactions with a TTT DSRC OBU (e.g. by automatic beacon ID change)
	3	action	Measure the timing of the SUT transmissions and of the tolling system uplinks and downlinks.
	4	verify	The transmissions of the SUT shall never overlap in time with a TTT DSRC uplink or a downlink - see clause 5.5.2 in ETSI TS 102 792 V1.2.1 [4].

5.2.2 Mitigation triggering

5.2.2.1 Mitigation triggering overview

Outside a protected zone the DUT is usually operating in normal mode.

There are two possible triggering events that cause a mobile ITS-G5 station to switch to coexistence mode:

1) The radio detection of a tolling station.

2) The entering of a protected zone known from stored data.
This protected zone information can be known ...

   - ... from a CAM received from a vehicle that includes temporary protected zone information, or ...
   - ... from a received infrastructure CAM that includes temporary protected zone information, or ...
   - ... from a received infrastructure CAM that includes permanent protected zone information, or ...
   - ... from an in-vehicle database.

There are several requirements that some of these methods shall always come together. This leads to a list of valid mandatory trigger event combinations.

NOTE: Optionally, all trigger event reasons can be implemented.

Depending on the ICS supported by the SUT the test purposes marked by "m" in table 2 shall be tested.

EXAMPLE 1: ICS 2 is "map based detection" and ICS 14 is "no database update method available" results to: TP_TRIG_MOBILE_02, TP_TRIG_MOBILE_04, and TP_TRIG_MOBILE_05

EXAMPLE 2: When ICS 1 and ICS 2 are supported, all triggering test purposes are applicable.

Table 2: TP selection scheme

Test purpose	**TP_TRIG_ MOBILE_01**	**TP_TRIG_ MOBILE_02**	**TP_TRIG_ MOBILE_03**	**TP_TRIG_ MOBILE_04**	**TP_TRIG_ MOBILE_05**
Short name ——— **ICS Item / value**	**Radio detection**	**Vehicle database**	**Vehicle CAM temporary**	**Infrastructure CAM temporary**	**Infrastructure CAM permanent**
ICS 1 / supported / Radio detection	m	-	m	m	m
ICS 2 / supported / Map based detection ICS 14 / supported / With database update method	-	m	-	m	-
ICS 2 / supported / Map based detection ICS 14 / not supported / **No** database update method in the field	-	m	-	m	m

5.2.2.2 Radio detection

This test purpose assesses the correct functioning of the TTT DSRC radio detection, the transmission of protected zone information in the CAM, and the correct application of a mitigation method.

TP_TRIG_MOBILE_01 shall be applied when the equipment manufacturer declared in ETSI TS 102 916-1 [2] the use of a TTT DSRC radio detection (ICS 1).

Identifier:	TP_TRIG_MOBILE_01
Summary:	TTT DSRC radio detection and triggering of CAM transmission
Configuration:	Specified in clause 5.3.3, clause 5.3.4, and clause 5.3.10.3.3 of ETSI EN 302 571 V2.1.1 [3]
SUT	Mobile ITS-G5 station (ICS 17), Personal device (ICS 18)
Specification Reference:	ETSI EN 302 571 V2.1.1 [3]
Pre-test conditions:	• Mandatory when SUT supports TTT DSRC radio detection (ICS 1)
Test Sequence:	**Description**
	see clause 5.3.10.3.3 of ETSI EN 302 571 V2.1.1 [3]

5.2.2.3 Map based detection

This test purpose assesses the correct functioning of the TTT DSRC map based detection and the correct application of a mitigation method.

TP_TRIG_MOBILE_02 shall be applied when the equipment manufacturer declared in ETSI TS 102 916-1 [2] the use of a TTT DSRC map based detection (ICS 2).

Identifier:	TP_TRIG_MOBILE_02		
Summary:	TTT DSRC map based detection		
Configuration:	See clause 4.3.		
SUT	Mobile ITS-G5 station (ICS 17), Personal device (ICS 18)		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	• Mandatory when SUT supports TTT DSRC map based detection (ICS 2)		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	• Connect the SUT to the test setup and activate normal (not coexistence) mode transmitting CAM messages at a rate of 10 Hz with maximum supported TX power level. • Connect the SUT to a GPS simulator, which can simulate the satellite signals for arbitrary geolocations.
	2	stimulus	• With the GPS simulator, simulate an approach to 5 randomly chosen toll stations from the official TTT DSRC location database. • At least 3 geolocations for each toll station shall be inside the protected zone.
	3	action	For the geolocations within the protected zone, perform all applicable mitigation method test purposes as specified in clause 5.2.1.
	4	verify	When the simulated SUT position is located within the protected zone of the chosen tolling station, the SUT shall be switched to coexistence mode.

5.2.2.4 Detection by temporary information from a vehicle CAM

This test purpose assesses the correct functioning of the TTT DSRC detection by reception of temporary protected zone information from a vehicle CAM and the correct application of a mitigation method.

TP_TRIG_MOBILE_03 shall be applied when the equipment manufacturer declared in ETSI TS 102 916-1 [2] the use of a TTT DSRC radio detection (ICS 1).

Identifier:	TP_TRIG_MOBILE_03		
Summary:	Reception of temporary protected zone information from a vehicle CAM		
Configuration:	See clause 4.4		
SUT	Mobile ITS-G5 station (ICS 17), Personal device (ICS 18)		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	• Mandatory when SUT supports TTT DSRC radio detection (ICS 1)		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	• Connect the SUT to the test setup and activate normal (not coexistence) mode transmitting CAM messages at a rate of 10 Hz with maximum supported TX power level. • Connect the SUT to a GPS simulator, which can simulate the satellite signals for arbitrary geolocations. • Connect the SUT to an ITS-G5 test system that is able to transmit a vehicle CAM with arbitrary temporary protected zone information and an infrastructure CAM with permanent protected zone information.
	2	stimulus	• A vehicle CAM with **temporary** protected zone information is transmitted by the ITS-G5 test system. The protected zone shall be closer to the SUT than the temporary protected zone geolocation stored in the SUT.
	3	stimulus	• An approach to the **temporary** toll station position which was included in the vehicle CAM sent in step 2 is simulated with the GPS simulator. • At least 3 geolocations shall be inside the protected zone.
	4	action	For the geolocations within the protected zone, perform all applicable mitigation method test purposes as specified in clause 5.2.1.
	5	loop	Repeat once from step 2 to step 4 with a different geolocation, to verify that the stored temporary protected zone information is overwritten by later received data that is closer to the SUT geolocation than the stored location.
	6	stimulus	• An infrastructure CAM with **permanent** protected zone information different from the temporary information is transmitted by the ITS-G5 test system.
	7	loop	Repeat once from step 3 to step 4, to verify that the stored temporary protected zone information sent in step 2 is **not** overwritten by the permanent protected zone information sent in step 6.
	8	verify	When the simulated SUT position is located within the protected zone of the tolling station announced in the vehicle CAM in step 2, the SUT shall be switched to coexistence mode.
	9	stimulus	• A vehicle CAM with **temporary** protected zone information is transmitted by the ITS-G5 test system. The protected zone shall be further away from the SUT than the temporary protected zone geolocation stored in the SUT.
	10	stimulus	• An approach to the **temporary** toll station position which was included in the vehicle CAM sent in step 9 is simulated with the GPS simulator. • At least 3 geolocations shall be inside the protected zone.
	11	verify	When the simulated SUT position is located within the protected zone of the tolling station announced in the vehicle CAM in step 9, the SUT shall **not** be switched to coexistence mode to show that the temporary toll station position from a position further away was not taken into account.

5.2.2.5 Detection by temporary information from an infrastructure CAM

This test purpose assesses the correct functioning of the TTT DSRC detection by reception of temporary protected zone information from an infrastructure CAM and the correct application of a mitigation method.

TP_TRIG_MOBILE_04 shall be applied when the equipment manufacturer declared in ETSI TS 102 916-1 [2] that the SUT is not operating permanently in coexistence mode (ICS 3 not supported).

Identifier:	TP_TRIG_MOBILE_04		
Summary:	Reception of temporary protected zone information from an infrastructure CAM		
Configuration:	See clause 4.4		
SUT	Mobile ITS-G5 station (ICS 17), Personal device (ICS 18)		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	• Mandatory for all mobile ITS-G5 stations not operating permanently in coexistence mode (ICS 3 not supported).		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	• Connect the SUT to the test setup and activate normal (not coexistence) mode transmitting CAM messages at a rate of 10 Hz with maximum supported TX power level. • Connect the SUT to a GPS simulator, which can simulate the satellite signals for arbitrary geolocations. • Connect the SUT to an ITS-G5 test system that is able to transmit an infrastructure CAM with arbitrary temporary or permanent protected zone information.
	2	stimulus	• An infrastructure CAM with one **temporary** protected zone information is transmitted by the ITS-G5 test system. The protected zone shall be closer to the SUT than the temporary protected zone geolocation stored in the SUT.
	3	stimulus	• An approach to the **temporary** toll station position which was included in the infrastructure CAM sent in step 2 is simulated with the GPS simulator. • At least 3 geolocations shall be inside the protected zone.
	4	action	For the geolocations within the protected zone, perform all applicable mitigation method test purposes as specified in clause 5.2.1.
	5	loop	Repeat once from step 2 to step 4 with a different geolocation, to verify that the stored temporary protected zone information is overwritten by later received temporary data that is closer to the SUT geolocation than the stored location..
	6	stimulus	• An infrastructure CAM with **permanent** protected zone information different from the temporary information is transmitted by the ITS-G5 test system.
	7	loop	Repeat once from step 3 to step 4, to verify that the stored temporary protected zone information sent in step 2 is **not** overwritten by the permanent protected zone information sent in step 6.
	8	verify	When the simulated SUT position is located within the protected zone of the tolling station announced in step 2, the SUT shall be switched to coexistence mode.
	9	stimulus	• An infrastructure CAM with one **temporary** protected zone information is transmitted by the ITS-G5 test system. The protected zone shall be further away from the SUT than the temporary protected zone geolocation stored in the SUT.
	10	stimulus	• An approach to the temporary toll station position which was included in the vehicle CAM sent in step 9 is simulated with the GPS simulator. • At least 3 geolocations shall be inside the protected zone.
	11	verify	When the simulated SUT position is located within the protected zone of the tolling station announced in the vehicle CAM in step 9, the SUT shall not be switched to coexistence mode to show that the temporary toll station position from a position further away was not taken into account.

5.2.2.6 Detection by permanent information from an infrastructure CAM

This test purpose assesses the correct functioning of the TTT DSRC detection by reception of permanent protected zone information from an infrastructure CAM and the correct application of a mitigation method.

TP_TRIG_MOBILE_05 shall be applied when the equipment manufacturer declares in ETSI TS 102 916-1 [2] that no protected zone database update method is available in the field (ICS 14 not supported).

Identifier:	TP_TRIG_MOBILE_05		
Summary:	Reception of permanent protected zone information from an infrastructure CAM		
Configuration:	See clause 4.4		
SUT	Mobile ITS-G5 station (ICS 17), Personal device (ICS 18)		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4]		
Pre-test conditions:	• Mandatory for all mobile ITS-G5 stations where no protected zone database update method is available in the field (ICS 14 not supported).		
Test Sequence:	**Step**	**Type**	**Description**
	1	setup	• Connect the SUT to the test setup and activate normal (not coexistence) mode transmitting CAM messages at a rate of 10 Hz with maximum supported TX power level. • Connect the SUT to a GPS simulator, which can simulate the satellite signals for arbitrary geolocations. • Connect the SUT to an ITS-G5 test system that is able to transmit an infrastructure CAM with arbitrary temporary or permanent protected zone information.
	2	stimulus	• An infrastructure CAM with a **permanent** protected zone information list with 16 entries is transmitted by the ITS-G5 test system.
	3	stimulus	• An approach to each of the 16 toll station positions which were included in the infrastructure CAM sent in step 2 is simulated with the GPS simulator. • At least 3 geolocations shall be inside the protected zone of each toll station.
	4	action	For the geolocations within the protected zone, perform all applicable mitigation method test purposes as specified in clause 5.2.1.
	5	loop	Repeat once from step 2 to step 4 with a different protected zone information list, to verify that the stored permanent protected zone information is overwritten by later received permanent data.
	6	stimulus	• An infrastructure CAM with **temporary** protected zone information, different from the permanent information list sent in step 2, is transmitted by the ITS-G5 test system.
	7	loop	Repeat once from step 3 to step 4, to verify that the stored permanent protected zone information sent in step 2 is **not** overwritten by the temporary protected zone information sent in step 6.
	8	verify	When the simulated SUT position is located within the protected zone of one of the tolling stations announced in step 2, the SUT shall be switched to coexistence mode.

History

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