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TECHNICAL SPECIFICATION

**Intelligent Transport Systems (ITS);
Testing;
Conformance test specifications for
Cooperative Awareness Basic Service (CA);
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 Conformance test specifications for Cooperative Awareness Basic Service (CA), as identified below:

Part 1: "Test requirements and Protocol Implementation Conformance Statement (PICS) pro forma";

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

Part 3: "Abstract Test Suite (ATS) and Protocol Implementation eXtra Information for Testing (PIXIT)".

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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document provides the Test Suite Structure and Test Purposes (TSS & TP) for Cooperative Awareness Basic Service (CA) as defined in ETSI EN 302 637-2 [1] in compliance with the relevant requirements and in accordance with the relevant guidance given in ISO/IEC 9646-7 [i.4].

The ISO standards for the methodology of conformance testing (ISO/IEC 9646-1 [i.2] and ISO/IEC 9646-2 [i.3]) as well as the ETSI rules for conformance testing (ETSI ETS 300 406 [i.5]) are used as a basis for the test methodology.

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 302 637-2 (V1.4.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[2] Void.

[3] ETSI TS 102 868-1 (V1.5.1): "Intelligent Transport Systems (ITS); Testing; Conformance test specifications for Cooperative Awareness Basic Service (CA); Part 1: Test requirements and Protocol Implementation Conformance Statement (PICS) pro forma".

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] ETSI EG 202 798 (V1.1.1): "Intelligent Transport Systems (ITS); Testing; Framework for conformance and interoperability testing".

[i.2] ISO/IEC 9646-1 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

[i.3] ISO/IEC 9646-2 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 2: Abstract Test Suite specification".

[i.4] ISO/IEC 9646-7 (1995): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 7: Implementation Conformance Statements".

[i.5]   ETSI ETS 300 406 (1995): "Methods for testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

3   Definition of terms, symbols and abbreviations

3.1   Terms

For the purposes of the present document, the terms given in ETSI EN 302 637-2 [1], ISO/IEC 9646-1 [i.2] and ISO/IEC 9646-7 [i.4] apply.

3.2   Symbols

Void.

3.3   Abbreviations

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

ACC	Adaptive Cruise Control
ATS	Abstract Test Suite
BTP	Basic Transport Protocol
BTP-B	Basic Transport Protocol Type B
BV	Valid test events for Behaviour tests
CA	Cooperative Awareness
CAM	Cooperative Awareness Messages
CAN	Controller Area Network
FMT	Message Format
GFQ	Generation Frequency
GN	GeoNetworking
INA	Information Adaptation
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems
ITS-AID	ITS Application Identifier
ITS-S	ITS Station
IUT	Implementation Under Test
LF	Low Frequency
MSD	Message Dissemination
MSP	Message Processing
PAR	lower-layer parameters
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
RSU	Road Side Unit
SHB	Single Hop Broadcast
SSP	Service Specific Permissions
TI	Timer tests
TP	Test Purposes
TS	Technical Specification
TSS	Test Suite Structure

4   Test Suite Structure (TSS)

4.1   Structure for CA tests

Table 1 shows the CA Test Suite Structure (TSS) including its sub-groups defined for conformance testing.

Table 1: TSS for CA

Root	Group	Sub-Group	Category
CAM	Message Dissemination		
		Message format	Valid
		Information adaptation	Valid
		Generation frequency	Valid and Timer
		Lower-layer parameters	Valid
	Message processing		Valid

The test suite is structured as a tree with the root defined as CAM. The tree is of rank 3 with the first rank a Group, the second a sub-group, and the third a category. The third rank is the standard ISO conformance test categories.

4.2   Test groups

4.2.1   Introduction

The test suite has a total of four levels. The first level is the root. The second level separates the root into various functional areas. The third level is the sub-functional areas if necessary. The fourth level is the standard ISO conformance test categories.

4.2.2   Root

The root identify the Co-operative Awareness Basic Service (CA) given in ETSI EN 302 637-2 [1].

4.2.3   Groups

This level contains two functional areas identified as:

- Message Dissemination

- Message Processing

4.2.4   Sub-Groups

This level contains four sub-functional areas identified only for the Message Dissemination group and defined as:

- Message format

- Information adaptation

- Generation frequency

- Lower-layer parameters

4.2.5   Categories

This level contains the standard ISO conformance test categories limited to the behaviour valid event and Timer.

5   Test Purposes (TP)

5.1   Introduction

5.1.1   TP definition conventions

The TP definition is built according to ETSI EG 202 798 [i.1].

5.1.2   TP Identifier naming conventions

The identifier of the TP is built according to table 2.

Table 2: TP naming convention

TP/<root>/<gr>/<sgr>/<x>/<nn> or TP/<root>/<gr>/<x>/<nn> or TP/<root>/<gr>/<x>/<nn>-<v>	Abbreviation	Description
<root> = root	CAM	Cooperative Awareness Message
<gr> = group	MSD	Message Dissemination
	MSP	Message Processing
<sgr> =sub- group	FMT	Message Format
	INA	Information Adaptation
	GFQ	Generation Frequency
	PAR	Lower-layer parameters
	SSP	Service Specific Permissions
<x> = type of testing	BV	Valid Behaviour tests
	TI	Timer tests
<nn> = sequential number		01 to 99
<v> = variant		01 to 99

5.1.3   Rules for the behaviour description

The description of the TP is built according to ETSI EG 202 798 [i.1].

The base standards are not using finite state machine concept. As a consequence, the test purposes use a generic "Initial State" that corresponds to a state where the IUT is ready for starting the test execution. Furthermore, the IUT shall be left in this "Initial State", when the test is completed.

Being in the "Initial State" refers to the starting point of the initial device configuration. There are no pending actions, no instantiated buffers or variables, which could disturb the execution of a test.

5.1.4   Sources of TP definitions

All TPs have been specified according to ETSI EN 302 637-2 [1].

5.1.5   Mnemonics for PICS reference

To avoid an update of all TPs when the PICS document is changed, table 3 introduces mnemonics name and the correspondence with the real PICS item number.

The 'PICS item' column refers to tables and items of ETSI TS 102 868-1 [3]. The 'PICS item' as defined in ETSI TS 102 868-1 [3] shall be used to determine the test applicability.

Table 3: Mnemonics for PICS reference

Mnemonic	PICS item
PICS_G5_RADIO_COMM	A.2/1
PICS_CV2X_RADIO_COMM	A.2/2
PICS_PUBLICTRANS	A.3/1
PICS_SPECIALTRANS	A.3/2
PICS_DANGEROUSGOODS	A.3/3
PICS_ROADWORKS	A.3/4
PICS_RESCUE	A.3/5
PICS_EMERGENCY	A.3/6
PICS_SAFETYCAR	A.3/7
PICS_RSU	A.1/1
PICS_CAM_RECEPTION	A.4/2
PICS_CAM_GENERATION	A.4/1
PICS_IS_IUT_SECURED	A.5/1

5.2   Test purposes for CA

5.2.0   Radio communication support

In all the clauses below, if neither PICS_G5_RADIO_COMM nor PICS_CV2X_RADIO_COMM are indicated, the test purpose shall apply for both ITS-G5 and LTE-V2X.

5.2.1   Message dissemination

5.2.1.1   Message format

TP Id	TP/CAM/MSD/FMT/BV-01
Test objective	Check that protocolVersion is set to 2 and messageID is set to 2
Reference	ETSI EN 302 637-2 [1], clause B.1
PICS Selection	PICS_CAM_GENERATION AND NOT PICS_IS_IUT_SECURED
Initial conditions	

with {
   the IUT being in the "initial state"
}	

Expected behaviour	

ensure that {
   when {
      a CAM is generated
   }
   then {
      the IUT sends a valid CAM
         containing ITS PDU header
            containing protocolVersion
               indicating value 2
            and containing messageID
               indicating value 2
}	

TP Id	TP/CAM/MSD/FMT/BV-02
Test objective	Check that LF container is included in first CAM since CA basic service activation
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU
Initial conditions	

```
with {
    the IUT being in the "initial state"
    and the IUT has not sent any CAM yet
}
```

Expected behaviour

```
ensure that {
    when {
        a CAM is generated
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing lowFrequencyContainer
}
```

TP Id	TP/CAM/MSD/FMT/BV-03
Test objective	Check that LF container is included if time elapsed since the generation of the last CAM with the low frequency container generation is equal to or greater than 500 ms
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU
Initial conditions	

```
with {
    the IUT being in the "initial state"
    and the IUT has sent a CAM
        containing cam
            containing camParameters
                containing lowFrequencyContainer at time TIME_1
    and the IUT has not sent CAM
        containing cam
            containing camParameters
                containing lowFrequencyContainer after TIME_1
}
```

Expected behaviour

```
ensure that {
    when {
        a CAM is generated at time TIME_2 >= (TIME_1 + 500 ms)
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing lowFrequencyContainer
}
```

TP Id	TP/CAM/MSD/FMT/BV-04
Test objective	Check that specialVehicle container is included in first CAM since CA basic service activation
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND (PICS_PUBLICTRANS OR PICS_SPECIALTRANS OR PICS_DANGEROUSGOODS OR PICS_ROADWORKS OR PICS_RESCUE OR PICS_EMERGENCY OR PICS_SAFETYCAR)
Initial conditions	
with { the IUT being in the "initial state" and the IUT is configured to advertise itself as a special vehicle and the IUT has not sent any CAM yet }	
Expected behaviour	
ensure that { when { a CAM is generated } then { the IUT sends a valid CAM containing cam containing camParameters containing specialVehicleContainer }	

TP Id	TP/CAM/MSD/FMT/BV-05
Test objective	Check that specialVehicle container is included if time elapsed since the generation of the last CAM with the special vehicle container generation is equal to or greater than 500 ms
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND (PICS_PUBLICTRANS OR PICS_SPECIALTRANS OR PICS_DANGEROUSGOODS OR PICS_ROADWORKS OR PICS_RESCUE OR PICS_EMERGENCY OR PICS_SAFETYCAR)
Initial conditions	
with { the IUT being in the "initial state" and the IUT has sent a CAM containing cam containing camParameters containing specialVehicleContainer at time TIME_1 and the IUT has not sent CAM containing cam containing camParameters containing specialVehicleContainer after TIME_1 }	
Expected behaviour	
ensure that { when { a CAM is generated at time TIME_2 >= (TIME_1 + 500 ms) } then { the IUT sends a valid CAM containing cam containing camParameters containing specialVehicleContainer }	

5.2.1.2   Information adaptation

TP Id	TP/CAM/MSD/INA/BV-01-X
Test objective	Check that latest value of in-vehicle data is included in CAM
Reference	ETSI EN 302 637-2 [1], clause 5.2
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU
Initial conditions	

```
with {
    the IUT being in the "initial state"
}
```

Expected behaviour

```
ensure that {
    when {
        the IUT is alerted about INFO
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing FIELD set to VALUE
}
```

Variants			
#	**INFO**	**FIELD**	**VALUE**
01	Curvature value	highFrequencyContainer .basicVehicleContainerHighFrequency .curvature	Measured value
02	Brake pedal being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .brakePedalEngaged	1
03	Brake pedal being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .brakePedalEngaged	0
04	Gas pedal being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .gasPedalEngaged	1
05	Gas pedal being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .gasPedalEngaged	0
06	Emergency brake being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .emergencyBrakeEngaged	1
07	Emergency brake being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .emergencyBrakeEngaged	0
08	Collision warning being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .collisionWarningEngaged	1
09	Collision warning being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .collisionWarningEngaged	0
10	ACC being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .accEngaged	1

Variants			
#	INFO	FIELD	VALUE
11	ACC being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accActive .brakePedalEngaged	0
12	Cruise control being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .cruiseControlEngaged	1
13	Cruise control being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .cruiseControlEngaged	0
14	Speed limiter being engaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .speedLimiterEngaged	1
15	Speed limiter control being disengaged	highFrequencyContainer .basicVehicleContainerHighFrequency .accelerationControl .speedLimiterEngaged	0
16	Low beam headlights being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .lowBeamHeadlightsOn	1
17	Low beam headlights being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .lowBeamHeadlightsOn	0
18	High beam headlights being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .highBeamHeadlightsOn	1
19	High beam headlights being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .highBeamHeadlightsOn	0
20	Left turn signal being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .leftTurnSignalOn	1
21	Left turn signal being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .leftTurnSignalOn	0
22	Right turn signal being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .rightTurnSignalOn	1
23	Right turn signal being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .rightTurnSignalOn	0
24	Daytime running lights being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .daytimeRunningLightsOn	1
25	Daytime running lights being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .daytimeRunningLightsOn	0

Variants			
#	INFO	FIELD	VALUE
26	Reverse light being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .reverseLightOn	1
27	Reverse light being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .reverseLightOn	0
28	Fog lights being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .fogLightOn	1
29	Fog lights being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .fogLightOn	0
30	Parking lights being engaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .parkingLightsOn	1
31	Parking lights being disengaged	lowFrequencyContainer .basicVehicleContainerLowFrequency .exteriorLights .parkingLightsOn	0
32	Heading value	highFrequencyContainer .basicVehicleContainerHighFrequency .heading	Measured value
33	Speed value	highFrequencyContainer .basicVehicleContainerHighFrequency .speed	Measured value
34	Drive direction value	highFrequencyContainer .basicVehicleContainerHighFrequency .driveDirection	Measured value
35	Yaw rate value	highFrequencyContainer .basicVehicleContainerHighFrequency .yawRate	Measured value

TP Id	TP/CAM/MSD/INA/BV-02
Test objective	Check that publicTransportContainer is included if vehicleRole is set to publicTransport(1)
Reference	ETSI EN 302 637-2 [1], clause B.11
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_PUBLICTRANS
Initial conditions	

with {
   the IUT being in the "initial state"
   the IUT's vehicle role being set to publicTransport(1)
}	

Expected behaviour	

ensure that {
   when {
      a CAM is generated
   }
   then {
      the IUT sends a valid CAM
         containing cam
            containing camParameters
            containing specialVehicleContainer
               containing publicTransportContainer
}	

TP Id	TP/CAM/MSD/INA/BV-03
Test objective	Check that specialTransportContainer is included if vehicleRole is set to specialTransport(2)
Reference	ETSI EN 302 637-2 [1], clause B.12
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_SPECIALTRANS
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT's vehicle role being set to specialTransport(2)
}
```

Expected behaviour	

```
ensure that {
    when {
        a CAM is generated
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing specialVehicleContainer
                        containing specialTransportContainer
}
```

TP Id	TP/CAM/MSD/INA/BV-04
Test objective	Check that dangerousGoodsContainer is included if vehicleRole is set to dangerousGoods(3)
Reference	ETSI EN 302 637-2 [1], clause B.13
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_DANGEROUSGOODS
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT's vehicle role being set to dangerousGoods(3)
}
```

Expected behaviour	

```
ensure that {
    when {
        a CAM is generated
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing specialVehicleContainer
                        containing dangerousGoodsContainer
}
```

TP Id	TP/CAM/MSD/INA/BV-05
Test objective	Check that roadWorksContainerBasic is included if vehicleRole is set to roadWork(4)
Reference	ETSI EN 302 637-2 [1], clause B.14
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_ROADWORKS
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT's vehicle role being set to roadWork(4)
}
```

Expected behaviour	

```
ensure that {
    when {
        a CAM is generated
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing specialVehicleContainer
                        containing roadWorksContainerBasic
}
```

TP Id	TP/CAM/MSD/INA/BV-06
Test objective	Check that rescueContainer is included if vehicleRole is set to rescue(5)
Reference	ETSI EN 302 637-2 [1], clause B.15
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_RESCUE
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT's vehicle role being set to rescue(5)
}
```

Expected behaviour	

```
ensure that {
    when {
        a CAM is generated
    }
    then {
        the IUT sends a valid CAM
            containing cam
                containing camParameters
                    containing specialVehicleContainer
                        containing rescueContainer
}
```

TP Id	TP/CAM/MSD/INA/BV-07
Test objective	Check that emergencyContainer is included if vehicleRole is set to emergency(6)
Reference	ETSI EN 302 637-2 [1], clause B.16
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_EMERGENCY
Initial conditions	

with {
   the IUT being in the "initial state"
   the IUT's vehicle role being set to emergency(6)
}

| **Expected behaviour** | |

ensure that {
   when {
      a CAM is generated
   }
   then {
      the IUT sends a valid CAM
         containing cam
            containing camParameters
               containing specialVehicleContainer
                  containing emergencyContainer
   }
}

TP Id	TP/CAM/MSD/INA/BV-08
Test objective	Check that safetyCarContainer is included if vehicleRole is set to safetyCar(7)
Reference	ETSI EN 302 637-2 [1], clause B.17
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND PICS_SAFETYCAR
Initial conditions	

with {
   the IUT being in the "initial state"
   the IUT's vehicle role being set to safetyCar(7)
}

| **Expected behaviour** | |

ensure that {
   when {
      a CAM is generated
   }
   then {
      the IUT sends a valid CAM
         containing cam
            containing camParameters
               containing specialVehicleContainer
                  containing safetyCarContainer
   }
}

5.2.1.3   Generation frequency

TP Id	TP/CAM/MSD/GFQ/TI-01
Test objective	Check that CAMs are not generated more frequently than T_GenCamMin
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	

with {
   the IUT being in the "initial state"
}

| **Expected behaviour** | |

ensure that {
   when {
      IUT sends a CAM
   }
   then {
      the IUT does not send any CAM before or upon expiry of T_GenCamMin
   }
}

TP Id	TP/CAM/MSD/GFQ/TI-02
Test objective	Check that CAMs are not generated less frequently than T_GenCamMax
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	
with { the IUT being in the "initial state" }	
Expected behaviour	
ensure that { when { IUT sends a CAM } then { the IUT sends another CAM before expiry of T_GenCamMax } }	

TP Id	TP/CAM/MSD/GFQ/TI-03
Test objective	Check that T_GenCam is set to T_GenCamMax after generating N_GenCam due to condition 2
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	
with { the IUT being in the "initial state" the IUT having sent a CAM at time TIME_1 the IUT having sent an anticipated CAM due to condition 1 at time (TIME_1 + INTERVAL_1) the IUT having sent (N_GenCam - 1) subsequent CAMs every INTERVAL_1 }	
Expected behaviour	
ensure that { when { the IUT sends CAM } then { the IUT sends another CAM after expiry of T_GenCamMax } }	

TP Id	TP/CAM/MSD/GFQ/BV-04
Test objective	Check that CAM is generated immediately when the time elapsed since the last CAM generation is equal to or greater than T_GenCam_Dcc and the absolute difference between current heading of the originating ITS-S (towards North) and heading included in previous CAM exceeds 4°
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT having sent a CAM at time TIME_1
        containing cam
            containing camParameters
                containing highFrequencyContainer
                    containing basicVehicleContainerHighFrequency
                        containing heading set to HEADING_1
    the IUT not having sent any other CAM
    the IUT is alerted about new heading value HEADING_2
        and abs(HEADING_2 – HEADING_1) > 4°
}
```

Expected behaviour

```
ensure that {
    when {
        T_GenCam_Dcc expires
    }
    then {
        the IUT sends a CAM immediately
    }
}
```

TP Id	TP/CAM/MSD/GFQ/BV-05
Test objective	Check that CAM is generated immediately when the time elapsed since the last CAM generation is equal to or greater than T_GenCam_Dcc and the current position and position included in previous CAM exceeds 4 m
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT having sent a CAM at time TIME_1
        containing cam
            containing camParameters
                containing basicContainer
                    containing referencePositionset to POSITION_1
    the IUT not having sent any other CAM
    the IUT is alerted about new position value POSITION_2
        and distance(POSITION_2, POSITION_1) > 4 m
}
```

Expected behaviour

```
ensure that {
    when {
        T_GenCam_Dcc expires
    }
    then {
        the IUT sends a CAM immediately
    }
}
```

TP Id	TP/CAM/MSD/GFQ/BV-06
Test objective	Check that CAM is generated immediately when the time elapsed since the last CAM generation is equal to or greater than T_GenCam_Dcc and the absolute difference between current speed and speed included in previous CAM exceeds 0,5 m/s
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT having sent a CAM at time TIME_1
        containing cam
            containing camParameters
                containing highFrequencyContainer
                    containing basicVehicleContainerHighFrequency
                        containing speed set to SPEED_1
    the IUT not having sent any other CAM
    the IUT is alerted about new speed value SPEED_2
        and abs(SPEED_2 – SPEED_1) > 0,5 m/s
}
```

Expected behaviour

```
ensure that {
    when {
        T_GenCam_Dcc expires
    }
    then {
        the IUT sends a CAM immediately
    }
}
```

TP Id	TP/CAM/MSD/GFQ/TI-07
Test objective	Check that CAM is generated immediately when the time elapsed since the last CAM generation is equal to or greater than T_GenCam and equal to or greater than T_GenCam_Dcc
Reference	ETSI EN 302 637-2 [1], clause 6.1.3
PICS Selection	PICS_CAM_GENERATION AND NOT PIC_RSU AND NOT PICS_CV2X_RADIO_COMM
Initial conditions	

```
with {
    the IUT being in the "initial state"
    the IUT having sent a CAM
}
```

Expected behaviour

```
ensure that {
    when {
        T_GenCam expires
        and T_GenCam_Dcc expires
    }
    then {
        the IUT sends another CAM
    }
}
```

TP Id	TP/CAM/MSD/GFQ/TI-08
Test objective	Check that maximum CAM generation frequency for RSU ITS-S is 1 Hz
Reference	ETSI EN 302 637-2 [1], clause 6.1.4
PICS Selection	PICS_CAM_GENERATION AND PICS_RSU
Initial conditions	
with { the IUT being in the "initial state" }	
Expected behaviour	
ensure that { when { IUT sends a CAM } then { the IUT does not send another CAM before 1 s } }	

5.2.1.4   Lower-layer parameters

TP Id	TP/CAM/MSD/PAR/BV-01
Test objective	Check that CAM is encapsulated in BTP type B packet
Reference	ETSI EN 302 637-2 [1], clause 5.3.4.1
PICS Selection	PICS_CAM_GENERATION AND NOT PICS_IS_IUT_SECURED
Initial conditions	
with { the IUT being in the "initial state" }	
Expected behaviour	
ensure that { when { a CAM is generated } then { the IUT sends a CAM encapsulated in a BTP-B packet } }	

TP Id	TP/CAM/MSD/PAR/BV-02
Test objective	Check that CAM is encapsulated in SHB packet
Reference	ETSI EN 302 637-2 [1], clause 5.3.4.1
PICS Selection	PICS_CAM_GENERATION AND NOT PICS_IS_IUT_SECURED
Initial conditions	
with { the IUT being in the "initial state" }	
Expected behaviour	
ensure that { when { a CAM is generated } then { the IUT sends a CAM encapsulated in a SHB packet } }	

TP Id	TP/CAM/MSD/PAR/BV-03
Test objective	Check that CAM is encapsulated in GN packet with lifetime less than 1 s
Reference	ETSI EN 302 637-2 [1], clause 5.3.4.1
PICS Selection	PICS_CAM_GENERATION AND NOT PICS_IS_IUT_SECURED
Initial conditions	

with {
   the IUT being in the "initial state"
}	

Expected behaviour	

ensure that {
   when {
      a CAM is generated
   }
   then {
      the IUT sends a CAM
         encapsulated in a GN packet
            containing Basic Header
               containing Lifetime field
                  indicating value less than 1 s
   }
}	

5.2.1.5   Service specific permissions

TP Id	TP/CAM/MSD/SSP/BO-01-X
Test objective	Check that the IUT does not send a CAM when its content is not permitted by signing certificate
Reference	ETSI EN 302 637-2 [1], clause 6.2.2.1; CR#0001 for EN 302 637-2 [1] ("Description of LanePosition in the CAM standard") (see note)
PICS Selection	PICS_CAM_GENERATION AND PICS_IS_IUT_SECURED AND PICS_X

Initial conditions

with {
    the IUT being in the "initial state"
    the IUT is authorized to sign CAMs with the certificate CERTIFICATE_X
        containing appPermission item
            containing psid
                indicating CAM ITS-AID
            containing bitmapSSP
                indicating bit at position SSP_BIT_X set to 0
}

Expected behaviour

ensure that {
    when {
        a CAM with container CONTAINER_X is generated
    }
    then {
        the IUT does not send this CAM
    }
}

Variants			
X	PICS_X	CERTIFICATE_X	Bit Position	CONTAINER_X
01		CERT_IUT_CAM_01	1 (80h 00h)	CenDsrcTollingZone/ ProtectedCommunicationZonesRSU
02	PICS_PUBLICTRANS	CERT_IUT_CAM_02	2 (40h 00h)	publicTransport/publicTransportContainer
03	PICS_SPECIALTRANS	CERT_IUT_CAM_03	3 (20h 00h)	specialTransport/specialTransportContainer
04	PICS_DANGEROUSGO ODS	CERT_IUT_CAM_04	4 (10h 00h)	dangerousGoods/dangerousGoodsContainer
05	PICS_ROADWORKS	CERT_IUT_CAM_05	5 (08h 00h)	roadwork/roadWorksContainerBasic
06	PICS_RESCUE	CERT_IUT_CAM_06	6 (04h 00h)	rescue/rescueContainer
07	PICS_EMERGENCY	CERT_IUT_CAM_07	7 (02h 00h)	emergency/emergencyContainer
08	PICS_SAFETYCAR	CERT_IUT_CAM_08	8 (01h 00h)	safetyCar/safetyCarContainer
09	PICS_ROADWORKS and PICS_RSU	CERT_IUT_CAM_09	9 (00h 80h)	closedLanes/RoadworksContainerBasic
10	PICS_EMERGENCY	CERT_IUT_CAM_10	10 (00h 40h)	requestForRightOfWay/EmergencyContainer: EmergencyPriority
11	PICS_EMERGENCY	CERT_IUT_CAM_11	11 (00h 20h)	requestForFreeCrossingAtATrafficLight/Emer gencyContainer: EmergencyPriority
12	PICS_SAFETYCAR	CERT_IUT_CAM_12	12 (00h 10h)	noPassing/SafetyCarContainer: TrafficRule
13	PICS_SAFETYCAR	CERT_IUT_CAM_13	13 (00h 08h)	noPassingForTrucks/SafetyCarContainer: TrafficRule
14	PICS_SAFETYCAR	CERT_IUT_CAM_14	14 (00h 04h)	speedLimit/SafetyCarContainer
NOTE: Available at https://docbox.etsi.org/ITS/Open/CRs/CR%20EN%20302%20637-2%230001.docx.			

5.2.2   Message processing

TP Id	TP/CAM/MSP/BV-01
Test objective	Check that content of received CAM is transmitted to applications and other facilities
Reference	ETSI EN 302 637-2 [1], clause 4.4
PICS Selection	PICS_CAM_RECEPTION
Initial conditions	

with {
    the IUT being in the "initial state"
}	

Expected behaviour	

ensure that {
    when {
        the IUT receives a valid CAM
    }
    then {
        the IUT forwards the CAM content to upper layers
        and the IUT forwards the CAM content to other facilities
    }
}	

TP Id	TP/CAM/MSP/SSP/BV-02
Test objective	Check that IUT discards CAM if CAM messages are not permitted in signing certificate
Reference	ETSI EN 302 637-2 [1], clause 6.2.2.1
PICS Selection	PICS_CAM_RECEPTION AND PICS_IS_IUT_SECURED
Initial conditions	

with {
    the IUT being in the "initial state"
}	

Expected behaviour	

ensure that {
    when {
        the IUT receives a secured CAM
            containing signing certificate
                not containing appPermission item
                    containing psid
                        indicating CAM ITS-AID
    }
    then {
        the IUT discards the CAM
        and the IUT does not forward the CAM content to upper layers
        and the IUT does not forward the CAM content to other facilities
    }
}	

TP Id	TP/CAM/MSP/SSP/BV-02-X
Test objective	Check that IUT discards CAM if SSP value of the signing certificate is not consistent with the provided containers
Reference	ETSI EN 302 637-2 [1], clause 6.2.2.1; CR#0001 for EN 302 637-2 [1] ("Description of LanePosition in the CAM standard") (see note)
PICS Selection	PICS_CAM_RECEPTION AND PICS_IS_IUT_SECURED

Initial conditions

with {
   the IUT being in the "initial state"
}

Expected behaviour

ensure that {
   when {
       the IUT receives a secured CAM
          containing container CONTAINER_X
          containing signing certificate
             containing appPermission item
                containing psid
                   indicating CAM ITS-AID
                containing bitmapSSP
                   not indicating SSP_BIT_X
   }
   then {
       the IUT discards the CAM
       and the IUT does not forward the CAM content to upper layers
       and the IUT does not forward the CAM content to other facilities
   }
}

Variants				
X	\multicolumn{2}{c}{**SSP_BIT_X**}		**CONTAINER_X**
	Octet	**Bit Position**	
01	1	0 (80h)	CenDsrcTollingZone/ProtectedCommunicationZonesRSU
02	1	1 (40h)	publicTransport/publicTransportContainer
03	1	2 (20h)	specialTransport/specialTransportContainer
04	1	3 (10h)	dangerousGoods/dangerousGoodsContainer
05	1	4 (08h)	roadwork/roadWorksContainerBasic
06	1	5 (04h)	rescue/rescueContainer
07	1	6 (02h)	emergency/emergencyContainer
08	1	7 (01h)	safetyCar/safetyCarContainer
09	2	0 (80h)	closedLanes/RoadworksContainerBasic
10	2	1 (40h)	requestForRightOfWay/EmergencyContainer: EmergencyPriority
11	2	2 (20h)	requestForFreeCrossingAtATrafficLight/EmergencyContainer: EmergencyPriority
12	2	3 (10h)	noPassing/SafetyCarContainer: TrafficRule
13	2	4 (08h)	noPassingForTrucks/SafetyCarContainer: TrafficRule
14	2	5 (04h)	speedLimit/SafetyCarContainer
NOTE:	Available at https://docbox.etsi.org/ITS/Open/CRs/CR%20EN%20302%20637-2%230001.docx.			

Annex A (informative):
Bibliography

- 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".

History

Document history		
V1.1.1	March 2011	Publication
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