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Technical Specification

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Road Transport and Traffic Telematics (RTTT);
Test specifications for
Dedicated Short Range Communication (DSRC)
transmission equipment;
Part 1: DSRC data link layer: medium access and logical link control;
Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP)**



Reference

DTS/ERM-TG37-001-2

Keywords

DSRC, MAC, LLC, testing, TSS&TP

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document is part 1, sub-part 2 of a multi-part deliverable covering Road Transport and Traffic Telematics (RTTT); test specifications for Dedicated Short Range Communication (DSRC) transmission equipment, as identified below:

Part 1: "DRSC datalink layer: medium access and Logical link control";

Sub-part 1: "Protocol Implementation Conformance Statement (PICS) proforma specification";

Sub-part 2: "Test Suite Structure and Test Purposes (TSS&TP)";

Sub-part 3: "Abstract Test Suite (ATS) and partial PIXIT proforma".

Part 2: "DRSC application layer".

1 Scope

The present document contains the Test Suite Structure (TSS) and Test Purposes (TP) to test the ERM/TG37 Dedicated Short Range Communication (DSRC); Data Link Control (DLC) layer.

The objective of the present document is to provide a basis for conformance tests for DSRC equipment giving a high probability of inter-operability between different manufacturer's equipment.

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [5] and ISO/IEC 9646-2 [6]) as well as the ETSI rules for conformance testing (ETS 300 406 [4]) are used as a basis for the test methodology.

2 References

The following documents contain provisions that, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

- [1] CEN EN 12795 (2003): "Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) - DSRC data link layer: medium access and logical link control".
- [2] CEN EN 12253 (2003): "Road Transport and Traffic Telematics (RTTT) - Dedicated short-range communication - Physical layer using microwave at 5,8 GHz".
- [3] CEN EN 13372 (2003): " Road Transport and Traffic Telematics (RTTT) - Dedicated short-range communication - Profiles for RTTT".
- [4] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [5] ISO/IEC 9646-1: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".
- [6] ISO/IEC 9646-2: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 2: Abstract Test Suite specification".
- [7] ISO/IEC 9646-6: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 6: Protocol profile test specification".
- [8] ISO/IEC 9646-7: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statements".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ISO/IEC 9646-7 [8], EN 12253 [2], EN 12795 [1] and EN 13372 [3] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ISO/IEC 9646-1 [5], ISO/IEC 9646-6 [7], ISO/IEC 9646-7 [8], EN 12795 [1] and the following apply:

BI	Invalid Behaviour tests
BST	Beacon Service Table
BV	Valid Behaviour tests
DLC	Data Link Control
DLL	Data Link Layer
DSRC	Dedicated Short Range Communication
EFC	Electronic Fee Collection
FCS	Frame Check Sequence
IUT	Implementation Under Test
LID	Link IDentifier
LLC	Logical Link Control
LPDU	Link layer Data Protocol Unit
LSDU	Link layer Service Datat Unit
MAC	Medium Access Control
OBU	On Board Unit
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
PrWA	MAC frame Private Window Allocation
PrWRq	MAC frame Private Window Request
RSU	Road Side Unit
SUT	System Under Test
TSS	Test Suite Structure
U13a	Uplink preamble length (duration) [2]
U8	Uplink bit rate [2]
VST	Vehicle Service Table

4 Test Suite Structure (TSS)

4.1 Structure

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

Table 1: TSS for DSRC DLC

Group	Type of SUT	Behaviour
DLC MAC Sub-layer	On Board Unit	Valid behaviour
		Invalid behaviour
	Road Side Unit	Valid behaviour
		Invalid behaviour
DLC LLC Sub-layer	On Board Unit	Valid behaviour
		Invalid behaviour
	Road Side Unit	Valid behaviour
		Invalid behaviour

4.2 Test groups

The test groups are organized in two groups. The first is designed for the DLC MAC sub-layer testing and the second is designed for DLC LLC sub-layer testing.

4.3 Type of SUT test groups

The type of SUT test groups are organized in two groups. The first is designed for the On Board Unit testing and the second is designed for Road Side Unit testing.

4.4 Behaviour test groups

4.4.1 Valid Behaviour (BV) tests

This test sub group shall verify that the IUT reacts in conformity with the EN, after receipt or exchange of a valid Protocol Data Units (PDUs). Valid PDUs means that the exchange of messages and the content of the exchanged messages are considered as valid.

4.4.2 Invalid Behaviour (BI) tests

This test sub group shall verify that the IUT reacts in conformity with the EN, after receipt of a syntactically invalid PDU.

5 Test Purposes (TP)

5.1 Introduction

5.1.1 TP definition conventions

The TPs are defined following particular rules as shown in table 1.

Table 2: TP definition rules

TP Id according to the TP naming conventions	Title
	Reference
	PICS Selection
	Initial condition
	Stimulus and Expected behaviour

TP Id	The TP Id is a unique identifier. It shall be specified according to the TP naming conventions defined in the clause below.
Title	Short description of test purpose objective.
Reference	The reference should contain the references of the subject to be validated by the actual TP (specification reference, clause, paragraph).
PICS Selection	Reference to the PICS statement involved for selection of the TP. Contains a boolean expression.
Initial condition	The condition defines in which initial state the IUT has to be to apply the actual TP.
Stimulus and Expected behaviour	Definition of the events the tester performs, and the events that are expected from the IUT to conform to the base specification.

5.1.2 TP naming conventions

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

Table 3: TP naming convention

Identifier:	TP/<layer>/<sut>/<x>-<nn>		
	<layer>	MAC	MAC sub-layer
		LLC	LLC sub-layer
	<sut> = type of SUT	OBU	On Board Unit
		RSU	Road Side Unit
	x = Type of testing	BV	Valid Behaviour Tests
		BI	Invalid Behaviour Tests
	<nn> = sequential number	(01-99)	Test Purpose Number

5.1.3 Sources of TP definitions

All TPs are specified according to EN 12795 [1] and EN 13372 [3] with side-information from EN 12253 [2].

5.2 MAC test purposes for On-Board Unit (OBU)

5.2.1 BV test purposes

Test sub-group objective:

- To test the behaviour of the IUT in relation to syntactically and contextual correct behaviour of the test system.

Test purposes:

TP/MAC/OBU/BV/01	Verify that the OBU can receive downlink frames of maximum allowed length as defined by N2.
	Reference: EN 12795 [1] clauses 7.3.3, 7.4.3.1.1 d) and annex A
	PICS Selection: table A.6/7
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends downlink frame containing BST, allocating N5 public uplink windows. The number of profiles in the profilelist shall be such, that the number of octets in the frame equals the maximum number as defined by N2. Verify IUT does send a PrWRq within one of the public uplink windows allocated.
TP/MAC/OBU/BV/02	Verify that the OBU can receive a downlink frame following immediately within T1 after the end of an uplink frame transmitted by the same OBU.
	Reference: EN 12795 [1] clauses 7.3.3 and annex A
	PICS Selection: table A.6/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends downlink frame containing BST, allocating N5 public uplink windows. Verify IUT sends a PrWRq in any of the public uplink windows allocated. Tester sends PrWA. Verify IUT sends a VST within the private uplink window allocated. Tester sends ACn command, e.g. DLL ECHO or EFC ECHO, such, that the preamble of the ACn command frame starts exactly T1 after the end of the last bit of the end flag of the VST frame. Verify IUT sends the ACn response.
TP/MAC/OBU/BV/03	Verify that the OBU implements the timing constraints T3, T4b and T5 for public uplink windows.
	Reference: EN 12795 [1] clauses 7.3.4.2 and annex A
	PICS Selection: table A.6/3 AND table A.6/5 AND table A.6/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends downlink frame containing BST, allocating N5 public uplink windows. Verify IUT sends a PrWRq in one of the public uplink windows allocated. Tester records time: <ul style="list-style-type: none"> Ts from the end of last bit of the end flag of the BST frame until the beginning of the preamble of the PrWRq frame, and time Te from the end of last bit of the end flag of the BST frame until the end of the last bit of the end flag of the PrWRq frame. Verify IUT behaves according to table 4. Repeat the previous steps until the IUT has selected each of the N5 public uplink windows at least once.

Table 4: Timing for public uplink window

Public uplink window number	Start time T_s	End time T_e
1	$T_3 < T_s < T_3 + T_{4b}$	$T_e < T_3 + T_5$
2	$T_3 + T_5 < T_s < T_3 + T_5 + T_{4b}$	$T_e < T_3 + 2 \cdot T_5$
...		
N5	$T_3 + ((N_5-1) \cdot T_5) < T_s < T_3 + ((N_5-1) \cdot T_5) + T_{4b}$	$T_e < T_3 + N_5 \cdot T_5$

TP/MAC/OBU/BV/04	Verify that the OBU can receive a downlink frame which follows another downlink frame immediately within T2.
	Reference: EN 12795 [1] clauses 7.3.3 and annex A
	PICS Selection: table A.6/2
	Initial condition: OBU being not initialized and not in sleep mode.
Stimulus and Expected Behaviour:	
<ol style="list-style-type: none"> 1. Tester sends a frame with a private LID, not allocating a frame. 2. Within T2, the tester sends downlink frame containing BST, allocating N5 public uplink windows. 3. Verify IUT sends a PrWRq in one of the public uplink windows allocated. 	

TP/MAC/OBU/BV/05	Verify that the OBU implements the timing constraints T3 and T4a and N3 for private uplink windows.
	Reference: EN 12795 [1] clauses 7.3.4.2 and annex A EN 12253 [2] clause 5.3
	PICS Selection: table A.6/3 AND table A.6/4 AND table A.6/8
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour:
<ol style="list-style-type: none"> 1. Tester performs an initialization cycle BST / PrWRq / PrWA / VST. 2. Tester records time: <ul style="list-style-type: none"> • T_s from the end of the last bit of the end flag of the PrWA frame allocating a private uplink window until the beginning of the preamble of the VST frame in the allocated private uplink window, and time. • T_e from the end of the last bit of the end flag of the PrWA frame allocating a private uplink window until the end of the last bit of the end flag of the VST frame in the allocated private uplink window. 3. Verify IUT behaves according to table 5. 	

Table 5: Timing for private uplink window

Start time T_s	End time T_e
$T_3 < T_s < T_3 + T_{4a}$	$T_e < T_3 + T_{4a} + U_{13a} + (8 \cdot N_3 + \text{stuff bits}) / U_8$

TP/MAC/OBU/BV/06	Verify that the OBU correctly manages the S-bit and L-Bit in the MAC control field for the purpose of possible re-transmission of VST frames.
	Reference: EN 12795 [1] clauses 7.3.2.1, 7.4.3.1.3 and 7.4.3.1.4
	PICS Selection: table A.7/2
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour:
<ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq in one of the public uplink windows allocated. 3. Tester sends PrWA and records the value of the S-bit used. 4. Tester ignores a possible reception of a VST in the allocated private uplink window. 5. Tester sends PrWA with the S-bit set to the same value as in step 3. 6. Verify IUT sends the VST. 	

TP/MAC/OBU/BV/07	Verify that the OBU correctly manages the local S-bit state variable based on the S-bit and L-Bit in the received MAC control field, where an LPDU is present in the allocating downlink frame.
	Reference: EN 12795 [1] clauses 7.3.2.1, 7.4.3.1.3 and 7.4.3.1.4
	PICS Selection: table A.7/2
	Initial condition: OBU being fully initialized and not in sleep mode.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends the EFC ECHO ACn command with ECHO_DATA1 and notes the value of the S-bit. 2. Verify IUT sends the EFC ECHO response with ECHO_DATA1. 3. Tester sends the EFC ECHO ACn command with ECHO_DATA2. The S-bit shall be set to the same value as used in step 1. 4. Verify IUT sends the EFC ECHO response with ECHO_DATA2. 5. Tester sends PrWA with the S-bit set to the same value as in step 3. 6. Verify IUT sends the EFC ECHO response with ECHO_DATA2.

TP/MAC/OBU/BV/08	Verify that the OBU randomly selects one of the N5 public uplink windows.
	Reference: EN 12795 [1] clause 7.3.4.3
	PICS Selection: table A.5/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 = three public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester records number of public uplink window selected. 4. Tester repeats steps 1 to 3 X times with X = 100. 5. Verify IUT selects all possible public uplink windows at least 0,3-X times.
NOTE : In case the test fails, increase value of X and repeat test.	

TP/MAC/OBU/BV/09	Verify that the OBU can detect and manage both valid values of the C/R-bit in the MAC control field of a PrWa frame.
	<i>Test does not apply for profiles 0/1 of EN 13372 [3]</i>
	Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)
	PICS Selection: table A.2/2 AND table A.4/6 AND NOT table E.1/1
	Initial condition: OBU not in sleep mode and not yet initialized.
Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends PrWRq in the allocated private uplink window. 3. Tester sends PrWA frame with the C/R-bit of the MAC control field set to 1. 4. Verify IUT sends VST in the allocated private uplink window. 5. Tester sends PrWA frame with the C/R-bit of the MAC control field set to 0. The S-bit shall have the same value as in step 3. 6. Verify IUT sends VST in the allocated private uplink window. 	

5.2.2 BI test purposes

Test sub-group objective:

- To check the behaviour of the IUT in response to invalid messages and behaviour from the test tool.

Test purposes:

TP/MAC/OBU/BI/01	<p>Verify that the OBU can detect and manage double-bit errors in the LID field, MAC control field and LPDU field of the downlink frame using the FCS field.</p> <p>Reference: EN 12795 [1] clauses 5.5 and 7.4.3.1.1 e)</p> <p>PICS Selection: table A.7/1 AND table A.7/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends downlink frame containing BST, allocating N5 public uplink windows, but introduces a random double-bit error in the frame on transmission. The bit error shall be introduced between the end of the start flag and the start of the FCS field. Verify IUT does not respond within any of the public uplink windows allocated. Repeat test in case the errors produced a flag or an abort sequence.
TP/MAC/OBU/BI/02	<p>Verify that the OBU can detect and manage double-bit errors in the FCS field of the downlink frame using the FCS field.</p> <p>Reference: EN 12795 [1] clauses 5.5 and 7.4.3.1.1 e)</p> <p>PICS Selection: table A.7/1 AND table A.7/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends downlink frame containing BST, allocating N5 public uplink windows, but introduces a random double-bit error in the FCS field on transmission. Verify IUT does not respond within any of the public uplink windows allocated. Repeat test in case the errors produced a flag or an abort sequence.
TP/MAC/OBU/BI/03	<p>Verify that the OBU can detect and manage a block of 15 bit errors in the downlink frame using the FCS field.</p> <p>Reference: EN 12795 [1] clauses 5.5 and 7.4.3.1.1 e)</p> <p>PICS Selection: table A.7/1 AND table A.7/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends downlink frame containing BST, allocating N5 public uplink windows, but introduces a block of 15 subsequent bit errors randomly located in the frame on transmission. The block of bit errors shall be introduced between the end of the start flag and the start of the end flag. Verify IUT does not respond within any of the public uplink windows allocated. Repeat test in case the errors produced a flag or an abort sequence.
TP/MAC/OBU/BI/04	<p>Verify that the OBU can detect and manage the abort sequence in the LPDU field of a downlink frame.</p> <p>Reference: EN 12795 [1] clauses 5.7 and 7.4.3.1.1</p> <p>PICS Selection: table A.7/1</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends downlink frame containing BST modified such, that the beaconld contains a sequence of seven consecutive one bits, allocating N5 public uplink windows. The zero-bit insertion shall not be applied to the beaconld field. The FCS shall be correct with respect to the actually transmitted frame. Verify IUT does not respond within any of the public uplink windows allocated.

TP/MAC/OBU/BI/05	Verify that the OBU can detect and manage the abort sequence at the end of a downlink frame.
	Reference: EN 12795 [1] clauses 5.7 and 7.4.3.1.1
	PICS Selection: table A.7/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST modified such, that the end flag is replaced by the abort sequence, allocating N5 public uplink windows. The FCS shall be correct. 2. Verify IUT does not respond within any of the public uplink windows allocated.
TP/MAC/OBU/BI/06	Verify that the OBU can detect and manage a downlink frame being too long according to N2.
	Reference: EN 12795 [1] clauses 7.3.3, 7.4.3.1.1 d) and annex A
	PICS Selection: table A.7/1 AND table A.6/7
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. The number of profiles in the profilelist shall be such, that the number of octets in the frame just exceeds by one the maximum number of octets allowed as defined by N2. 2. Verify IUT does not respond within any of the public uplink windows allocated.
TP/MAC/OBU/BI/07	Verify that the OBU can detect and manage wrong format of private LID in a downlink frame.
	Reference: EN 12795 [1] clauses 5.2.1, 7.4.3.1.1 b) and 7.4.3.1.3
	PICS Selection: table A.7/1 AND table A.4/3
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated using private LID = LID1. 3. Tester sends PrWA with private LID = LID1, but contained in five octets. 4. Verify IUT does not send VST in the allocated private uplink window.
TP/MAC/OBU/BI/08	Verify that the OBU can detect and manage a missing MAC control field in a downlink frame.
	Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)
	PICS Selection: table A.7/1 AND table A.4/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester sends PrWA, but without a MAC control field in it. 4. Verify IUT does not send VST in the allocated private uplink window.
TP/MAC/OBU/BI/09	Verify that the OBU can detect and manage a wrong A-bit in the MAC control field in a broadcast downlink frame.
	Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)
	PICS Selection: table A.7/1 AND table A.4/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, but the A-bit of the MAC control field set to 0. 2. Verify IUT does not send PrWRq within the time normally used for the N5 subsequent public uplink windows.

TP/MAC/OBU/BI/10	<p>Verify that the OBU can detect and manage a wrong D-bit in the MAC control field in a broadcast downlink frame.</p> <p>Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)</p> <p>PICS Selection: table A.7/1 AND table A.4/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows, but the D-bit of the MAC control field set to 1. 2. Verify IUT does not send PrWRq in the allocated private uplink window.
TP/MAC/OBU/BI/11	<p>Verify that the OBU can detect and manage a wrong D-bit in the MAC control field in a private downlink frame.</p> <p>Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)</p> <p>PICS Selection: table A.7/1 AND table A.4/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester sends PrWA, but the D-bit of the MAC control field set to 1. 4. Verify IUT does not send VST in the allocated private uplink window.
TP/MAC/OBU/BI/12	<p>Verify that the OBU can detect and manage a wrong L-bit in the MAC control field in a broadcast downlink frame.</p> <p>Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)</p> <p>PICS Selection: table A.7/1 AND table A.4/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows, but the L-bit of the MAC control field set to 0. 2. Verify IUT does not send PrWRq in the allocated private uplink window.
TP/MAC/OBU/BI/13	<p>Verify that the OBU can detect and manage a wrong L-bit in the MAC control field in a private downlink frame.</p> <p>Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)</p> <p>PICS Selection: table A.7/1 AND table A.4/6</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester sends PrWA, but the L-bit of the MAC control field set to 1. 4. Verify IUT does not send VST in the allocated private uplink window.
TP/MAC/OBU/BI/14	<p>Verify that the OBU can detect and manage a wrong C/R-bit in the MAC control field of a PrWa frame.</p> <p><i>Test applies only for profiles 0/1 of EN 13372 [3].</i></p> <p>Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c) EN 13372 [3] clause 6.4.2</p> <p>PICS Selection: table A.7/1 AND table A.4/6 AND table E.1/1</p> <p>Initial condition: OBU not in sleep mode and not yet initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends PrWRq in the allocated private uplink window. 3. Tester sends PrWA frame with the C/R-bit of the MAC control field set to 1. 4. Verify IUT does not sent VAT in the allocated private uplink window. 5. Tester sends PrWA frame. 6. Verify IUT sends VST in the allocated private uplink window.

TP/MAC/OBU/BI/15	Verify that the OBU can detect and manage a wrong MAC control field in a downlink frame.
	Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)
	PICS Selection: table A.7/1 AND table A.4/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester sends PrWA, but with all X bits in the MAC control field set to 1. 4. Verify IUT does not send VST in the allocated private uplink window.
TP/MAC/OBU/BI/16	Verify that the OBU can detect and manage blocked signals in a downlink frame.
	Reference: EN 12795 [1] clause 5.1, 5.7 and 7.4.3.1.1 e)
	PICS Selection: table A.7/1 AND table A.7/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows, but the radio signal is blocked for 15 consecutive bit periods in the frame on transmission. The blocked bits shall be between the end of the start flag and the start of the end flag. 2. Verify IUT does not respond within any of the public uplink windows allocated.
TP/MAC/OBU/BI/17	Verify that the OBU can detect and manage a blocked end flag in a downlink frame.
	Reference: EN 12795 [1] clause 7.4.3.1.1 a)
	PICS Selection: table A.7/1 AND table A.7/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows, but the radio signal is blocked during transmission of the end flag in the frame. 2. Verify IUT does not respond within any of the public uplink windows allocated.
TP/MAC/OBU/BI/18	Verify that the OBU can detect and manage a blocked start flag in a downlink frame.
	Reference: EN 12795 [1] clause 7.4.3.1.1 a)
	PICS Selection: table A.7/1 AND table A.7/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows, but the radio signal is blocked for the start flag in the frame on transmission. 2. Verify IUT does not respond within any of the public uplink windows allocated.
TP/MAC/OBU/BI/19	Verify that the OBU can detect and manage a broadcast LID where a private LID should be used in a downlink frame.
	Reference: EN 12795 [1] clauses 5.2.1, 5.2.2, 7.4.3.1.1 b) and 7.4.3.1.3
	PICS Selection: table A.7/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated using private LID = LID1. 3. Tester sends PrWA, but using broadcast LID instead of LID1. 4. Verify IUT does not send VST in the allocated public uplink windows. 5. Tester sends PrWA with private LID=LID1 and the MAC S-Bit set to S=0. 6. Verify IUT sends VST in the allocated private uplink window.

TP/MAC/OBU/ BI/20	Verify that the OBU can detect and manage a multicast LID where a private LID should be used in a downlink frame.
	Reference: EN 12795 [1] clauses 5.2.1, 5.2.3, 7.4.3.1.1 b) and 7.4.3.1.3
	PICS Selection: table A.7/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated using private LID = LID1. The seven least significant bits of LID1 shall not be all 1. 3. Tester sends MAC frame with A-Bit set to 1 and with multicast address such that the link address field equals the least significant octet of link address field for LID1. 4. Verify IUT does not send VST in the allocated uplink window. 5. Tester sends PrWA with private LID=LID1 and the MAC S-Bit set to S=0. 6. Verify IUT sends VST in the allocated private uplink window.
NOTE:	In the event of the OBU under test has implemented a multicast address, this multicast address shall not be used for the test.

TP/MAC/OBU/ BI/21	Verify that the OBU can detect and manage a wrong A-bit in the MAC control field in a private downlink frame.
	Reference: EN 12795 [1] clauses 7.3.2.1 and 7.4.3.1.1 c)
	PICS Selection: table A.7/1 AND table A.4/6 AND table A.7/2
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester sends PrWA, but the A-bit of the MAC control field set to 0. 4. Verify IUT does not send VST within the time expected for a private uplink window. 5. Tester sends PrWA. 6. Verify IUT sends VST in the allocated private uplink window.

TP/MAC/OBU/ BI/22	Verify that the OBU can manage a wrong A-bit in the MAC control field in a private downlink frame containing an ACn command.
	<i>Test does not apply for profiles 0/1 of EN 13372 [3].</i>
	Reference: EN 12795 [1] clauses 7.3.2.1, 7.4.3.2 and 7.4.3.1.1 c)
	PICS Selection: table A.7/1 AND table A.4/6
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated. 3. Tester sends PrWA. 4. Verify IUT sends VST within the time expected for a private uplink window. 5. Tester sends ACn command that requires a response from the application layer, e.g. ECHO command, and with MAC A-bit set to zero. 6. Verify IUT does not send the ACn response immediately following the command within the time normally used for a private uplink window. 7. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 8. Verify IUT does not send a PrWRq within one of the public uplink windows allocated.

TP/MAC/OBU/BI/23	Verify that the OBU can detect and manage wrong private LID in a downlink frame.
	Reference: EN 12795 [1] clauses 5.2.1, 7.4.3.1.1 b) and 7.4.3.1.3
	PICS Selection: table A.7/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends downlink frame containing BST, allocating N5 public uplink windows. 2. Verify IUT sends a PrWRq within one of the public uplink windows allocated using private LID = LID1. 3. Tester sends PrWA with private LID different to LID1, but with correct format. 4. Verify IUT does not send VST in the allocated private uplink window. 5. Tester sends PrWA with private LID = LID1. 6. Verify IUT sends VST in the allocated private uplink window.

5.3 MAC test purposes for Road-Side Unit

5.3.1 BV test purposes

Test sub-group objective:

- To test the behaviour of the IUT in relation to syntactically and contextual correct behaviour of the test system.

Test purposes:

TP/MAC/RSU/BV/01	Verify that the RSU can receive uplink frames of maximum allowed length in private uplink windows defined by N3.
	Reference: EN 12795 [1] clauses 7.3.4.1, 7.4.2.1.1 e) and annex A
	PICS Selection: table B.6/8
	Initial condition: RSU is running any application, and is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT allocates a private uplink window. 3. Tester sends VST in the allocated private uplink window. The length of the applicationList shall be such that the number of octets in the frame equals the maximum number as defined by N3. 4. Verify IUT sends a privately addressed frame in order to acknowledge reception of the VST.

TP/MAC/RSU/BV/02	Verify that the RSU implements the timing constraint T1.
	Reference: EN 12795 [1] clauses 7.3.3 and annex A
	PICS Selection: table B.6/1
	Initial condition: RSU is running any application, and is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester and IUT perform a complete initialization cycle including the privately addressed acknowledge frame following BST. Tester records time: <ul style="list-style-type: none"> • T from the end of the last bit of the end flag in an uplink window (= rWRq frame) until the beginning of the preamble of the frame in the subsequent downlink window. In case of public uplink windows, the number of the selected window is considered to calculate the proper window timing. for the whole application cycle, where applicable. 2. Verify IUT complies with the requirement for T1 always.

TP/MAC/RSU/BV/03	<p>Verify that the RSU implements the correct private medium response time N12 for re-allocations of private uplink windows.</p> <p>Reference: EN 12795 [1] clauses 7.4.2.2.3 and annex A</p> <p>PICS Selection: table B.7/5</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. The repetition rate for BST transmissions shall be set such, that in between subsequent BST transmissions several PrWA frames are possible. No LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester send PrWRq in one of the allocated public uplink windows. 2. Verify the IUT sends PrWA. 3. Tester ignores all possible receptions of PrWA frames and reception of all subsequent BST frames. 4. Verify IUT repeats PrWA only until it transmits the next BST.
TP/MAC/RSU/BV/04	<p>Verify that the RSU implements the correct S-bit mechanism for re-allocations of private uplink windows and performs correct initialization of the S-bit.</p> <p>Reference: EN 12795 [1] clauses 7.4.2.2.2, 7.4.2.2.3 and annex A</p> <p>PICS Selection: table B.7/4 and table B.7/5</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. The repetition rate for BST transmissions shall be set such, that in between subsequent BST transmissions several PrWA frames are possible. No LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWRq with LID=LID1 in one of the allocated public uplink windows. 2. Verify the IUT sends PrWA. 3. Tester records the value of the S-bit received and ignores all possible receptions of PrWA frames. 4. Verify ITU only uses S=0. 5. Tester sends PrWRq with LID=LID1 in one of the allocated public uplink windows following the second BST frame. 6. Verify the IUT sends PrWA. 7. Tester records the value of the S-bit received and ignores all possible receptions of PrWA frames. 8. Verify ITU only uses S=0.
TP/MAC/RSU/BV/05	<p>Verify that the RSU can detect and manage the unusual value of the C/R-bit in the MAC control field of a PrWRq frame.</p> <p><i>Test does not apply for profiles 0/1 of EN 13372 [3].</i></p> <p>Reference: EN 12795 [1] clauses 7.3.2.2 and 7.4.2.1.1 d)</p> <p>PICS Selection: table B.4/7 AND table B.7/1 AND NOT table F.1/1</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWR in one of the N5 public uplink windows with the C/R-bit of the MAC control field set to 1 (=response). 2. Verify IUT sends PrWA.

5.3.2 BI test purposes

Test sub-group objective:

- To check the behaviour of the IUT in response to invalid messages and behaviour from the test tool.

Test purposes:

TP/MAC/RSU/BI/01	<p>Verify that the RSU can detect and manage double-bit errors in the information field of the LPDU of the uplink frame using the FCS field.</p> <p>Reference: EN 12795 [1] clauses 5.5 and 7.4.2.1.1 f)</p> <p>PICS Selection: table B.7/1 AND table B.7/7</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends PrWRq in one of the allocated public uplink windows. Verify IUT responds with PrWA. Tester sends VST but introduces a random double-bit error in the frame on transmission. The bit error shall be introduced in the information field of the LPDU. Verify IUT does not respond with a privately addressed frame. Repeat test in case the errors produced a flag or an abort sequence.
TP/MAC/RSU/BI/02	<p>Verify that the RSU can detect and manage double-bit errors in the FCS field of the uplink frame using the FCS field.</p> <p>Reference: EN 12795 [1] clauses 5.5 and 7.4.2.1.1 f)</p> <p>PICS Selection: table B.7/1 AND table B.7/7</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends PrWRq in one of the allocated public uplink windows, but introduces a random double-bit error in FCS field on transmission. Verify IUT does not respond within any of the public uplink windows allocated. Repeat test in case the errors produced a flag or an abort sequence.
TP/MAC/RSU/BI/03	<p>Verify that the RSU can detect and manage a block of 15 bit errors in the uplink frame using the FCS field.</p> <p>Reference: EN 12795 [1] clauses 5.5 and 7.4.2.1.1 f)</p> <p>PICS Selection: table B.7/1 AND table B.7/7</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> Tester sends PrWRq in one of the allocated public uplink windows. Verify IUT sends PrWA. Tester sends VST in the allocated private uplink window, but introduces a block of 15 subsequent bit errors randomly located in the frame on transmission. The block of bit errors shall be introduced in the information field of the LPDU. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1. Repeat test in case the errors produced a flag or an abort sequence.

TP/MAC/RSU/BI/04	Verify that the RSU can detect and manage the abort sequence in the LPDU field of an uplink frame.
	Reference: EN 12795 [1] clauses 5.7 and 7.4.2.1.1 a)
	PICS Selection: table B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST in the allocated private uplink window such, that the ObeConfiguration contains a sequence of seven consecutive one bits. The zero-bit insertion shall not be applied to the obeConfiguration field. The FCS shall be correct with respect to the actually transmitted frame. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/05	Verify that the RSU can detect and manage the abort sequence at the end of an uplink frame.
	Reference: EN 12795 [1] clauses 5.7 and 7.4.2.1.1 a)
	PICS Selection: table B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows modified such, that the end flag is replaced by the abort sequence (last bit of end flag set to "1"). The FCS shall be correct. 2. Verify IUT does not respond within PrWA.
TP/MAC/RSU/BI/06	Verify that the RSU can detect and manage a frame in a private uplink window being too long according to N3.
	Reference: EN 12795 [1] clauses 7.3.4.1, 7.4.2.1.1 e) and annex A
	PICS Selection: table B.6/8 AND table B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST, The length of applicationList shall be such that the number of octets in the frame just exceeds by one the maximum number of octets allowed as defined by N3. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/07	Verify that the RSU can detect and manage wrong private LID in an uplink frame.
	Reference: EN 12795 [1] clauses 5.2.1, 7.4.2.1.1 c) and 7.4.2.2.2
	PICS Selection: table B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST, but uses a new private LID. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.

TP/MAC/RSU/BI/08	<p>Verify that the RSU can detect and manage wrong format of private LID in an uplink frame.</p> <p>Reference: EN 12795 [1] clauses 5.2.1, 7.4.2.1.1 c) and 7.4.2.2.2</p> <p>PICS Selection: table B.4/3</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST, but private LID contained in five octets. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/09	<p>Verify that the RSU can detect and manage broadcast LID in case private LID is to be used in an uplink frame.</p> <p>Reference: EN 12795 [1] clauses 5.2.2, 7.4.2.1.1 c) and 7.4.2.2.2</p> <p>PICS Selection: table B.7/1</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST, but with broadcast address instead of private LID. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/10	<p>Verify that the RSU can detect and manage multicast LID in case private LID is to be used in an uplink frame.</p> <p>Reference: EN 12795 [1] clauses 5.2.3, 7.4.2.1.1 c) and 7.4.2.2.2</p> <p>PICS Selection: table B.7/1</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST, but with multicast address instead of private LID. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/11	<p>Verify that the RSU can detect and manage a missing MAC control field in an uplink frame.</p> <p>Reference: EN 12795 [1] clauses 5.3, 7.3.2.2 and 7.4.2.1.1 d)</p> <p>PICS Selection: table B.4/1 AND table B.7/1</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but without a MAC control field in it. 2. Verify IUT does not send PrWA.
TP/MAC/RSU/BI/12	<p>Verify that the RSU can detect and manage a wrong D-bit in the MAC control field in a frame in a public uplink window.</p> <p>Reference: EN 12795 [1] clauses 5.3, 7.3.2.2 and 7.4.2.1.1 d)</p> <p>PICS Selection: table B.4/7 and B.7/1</p> <p>Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but the D-bit of the MAC control field set to 0. 2. Verify IUT does not send PrWA.

TP/MAC/RSU/BI/13	Verify that the RSU can detect and manage a wrong D-bit in the MAC control field in a frame in a private uplink window.
	Reference: EN 12795 [1] clauses 5.3, 7.3.2.2 and 7.4.2.1.1 d)
	PICS Selection: table B.4/7 and B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST in the allocated private uplink window, but the D-bit of the MAC control field set to 0. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/14	Verify that the RSU can detect and manage a wrong L-bit in the MAC control field in a frame in a public uplink window.
	Reference: EN 12795 [1] clauses 5.3, 7.3.2.2 and 7.4.2.1.1 d)
	PICS Selection: table B.4/7 and B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but the L-bit of the MAC control field set to 1. 2. Verify IUT does not send PrWA.
TP/MAC/RSU/BI/15	Verify that the RSU can detect and manage a wrong L-bit in the MAC control field in a frame in a private uplink window.
	Reference: EN 12795 [1] clauses 5.3, 7.3.2.2 and 7.4.2.1.1 d)
	PICS Selection: table B.4/7 and B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST in the allocated private uplink window, but the L-bit of the MAC control field set to 0. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/16	Verify that the RSU can detect and manage a wrong MAC control field in a frame in a public uplink window.
	Reference: EN 12795 [1] clauses 5.3, 7.3.2.2 and 7.4.2.1.1 d)
	PICS Selection: table B.4/7 and B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but with all X bits in the MAC control field set to 1. 2. Verify IUT does not send PrWA.

TP/MAC/RSU/BI/17	Verify that the RSU can detect and manage blocked signals in an uplink frame.
	Reference: EN 12795 [1] clause 5.1, 5.7 and 7.4.2.1.1 f)
	PICS Selection: table B.7/1 AND table B.7/7
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows. 2. Verify IUT sends PrWA. 3. Tester sends VST in the allocated private uplink window, but blocks 15 consecutive bit periods in the frame on transmission. The blocked bits shall be introduced in the information field of the LPDU. 4. Verify IUT does not acknowledge reception of the VST by sending a privately addressed frame with the MAC L-bit set to 1.
TP/MAC/RSU/BI/18	Verify that the RSU can detect and manage a blocked end flag in an uplink frame.
	Reference: EN 12795 [1] clause 5.1, 7.4.2.1.1 a)
	PICS Selection: table B.7/1 AND table B.4/2
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but blocks the end flag in the frame on transmission. 2. Verify IUT does not respond with PrWA.
TP/MAC/RSU/BI/19	Verify that the RSU can detect and manage a blocked start flag in an uplink frame.
	Reference: EN 12795 [1] clause 5.1, 7.4.2.1.1 a)
	PICS Selection: table B.7/1 AND table B.4/2
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but blocks the start flag in the frame on transmission. 3. Verify IUT does not respond with PrWA.
TP/MAC/RSU/BI/20	Verify that the RSU can detect and manage a wrong R-bit in the MAC control field in a frame in a public uplink window.
	Reference: EN 12795 [1] clauses 7.3.2.2 and 7.4.2.1.1 d)
	PICS Selection: table B.4/7 and table B.7/1
	Initial condition: RSU is periodically inviting for initialization, i.e. sending BST with subsequent allocation of N5 public uplink windows. No private LID is registered.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends PrWRq in one of the allocated public uplink windows, but the R-bit of the MAC control field set to 0. 2. Verify IUT does not send PrWA.

5.4 LLC test purposes for On-Board Unit

5.4.1 BV test purposes

Test sub-group objective:

- To test the behaviour of the IUT in relation to syntactically and contextual correct behaviour of the test system.

Test purposes:

TP/LLC/OBU/BV/01	Verify that the OBU can exchange UI commands.
	Reference: EN 12795 [1] clause 8.4.2
	PICS Selection: table A2/2
	Initial condition: OBU not in sleep mode and not yet initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends an UI command containing a BST. Verify IUT replies with an UI command containing a VST, with the poll bit in the LLC control field set to P=0.
TP/LLC/OBU/BV/02	Verify that the OBU can manage ACn data transmission.
	Reference: EN 12795 [1] clause 8.4.3.5
	PICS Selection: table A.8/2 AND table A.13/2
	Initial condition: OBU initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends an AC0 command with Poll bit set to 0. Verify IUT replies with an AC1 response with Final bit set to 0 and status subfield equal to NR_OK. Tester sends an AC1 command with Poll bit set to 0. Verify IUT replies with an AC0 response with Final bit set to 0 and status subfield equal to NR_OK.
TP/LLC/OBU/BV/03	Verify that the OBU can manage ACn data exchange.
	Reference: EN 12795 [1] clause 8.4.3.5
	PICS Selection: table A.8/2 AND table A.13/3
	Initial condition: OBU initialized, prepared to allow for retrieval of data without causing late response.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends an AC0 command with poll bit set to P=1 requesting retrieval of data from the IUT. Verify IUT provides the requested data in the LSDU subfield of an AC1 response, with final bit set to F=1 and with the status subfield indicating OK_OK. Tester sends an AC1 command with poll bit set to P=1 requesting retrieval of data from the IUT. Verify IUT provides the requested data in the LSDU subfield of an AC0 response, with final bit set to F=1 and with the status subfield indicating OK_OK.
TP/LLC/OBU/BV/04	Verify that the OBU can manage correctly a Data Link Echo command.
	Reference: EN 12795 [1] clauses 8.4.3.2, 8.4.3.3
	PICS Selection: table A.8/2 AND table A.13/1
	Initial condition: OBU initialized.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> Tester sends a Data Link Echo. Verify IUT replies to the Data Link Echo received with the F bit set to F=0, the status subfield set to NR_OK and the LSDU subfield being empty.

TP/LLC/OBU/BV/05	Verify that the OBU can manage late response Procedure I
	Reference: EN 13372 [3] clause 7.2
	PICS Selection: table E.4/1
	Initial condition: OBU already initialized, waiting to be served by tester.
	<p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends application layer request for data retrieval from the OBU that causes late response. 2. Verify IUT sends ACn response frame with LLC status subfield containing the value NE_OK, but not providing the requested data. 3. Tester waits for at least the time needed to make the requested data available at the IUT. 4. The MAC of the tester re-transmits the request from step 1. 5. Observe whether IUT provides the data requested in step 1 in the response frame related to step 4. If it does, go to step 8. 6. Tester sends INITIALIZATION.request (BST) with FlowControl=2, granting immediately a private uplink window, if requested. 7. Verify IUT provides the data requested in step 1 using a UI command. <p>If in step 4 the IUT does not provide the data requested, proceed as follows:</p> <ol style="list-style-type: none"> 8. Tester invites for initialization using a new BeaconID and processes correctly all requests from the IUT until reception of VST. 9. As first command after reception of VST, tester sends application layer request for data retrieval from the OBU that causes late response. 10. Verify IUT sends ACn response frame with LLC status subfield containing the value NE_OK, but not providing the requested data. 11. Tester waits for at least the time needed to make the requested data available at the IUT. 12. Tester sends INITIALIZATION.request (BST) granting immediately a private uplink window, if requested. 13. Verify IUT provides the data requested in step 9 using a UI command.
<p>NOTE: Problems at the application caused by possible double reception of the requested data, see step 8, are not considered in this test, as such problems are outside the scope of DSRC.</p>	

5.4.2 BI test purposes

Test sub-group objective:

- to check the behaviour of the of the IUT in response to invalid messages and behaviour from the test tool.

Test purposes:

TP/LLC/OBU/BI/01	Verify that the OBU can correctly detect and manage corrupted LLC control field when a UI command is expected.
	Reference: EN 12795 [1] clauses 8.4.2.1, 8.3.2.2
	PICS Selection: table A.2/2 AND A.8/1 AND table A.9/1
	Initial condition: OBU not in sleep mode and not yet initialized.
	<p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends an UI command containing a BST, with the two least significant bits in the LLC control field being set to zero. 2. Verify IUT ignores the received LPDU. 3. Repeat steps 1 and 2 for all invalid values of the reserved bits in the LLC control field, with new beaconID in each trial. 4. Tester sends a valid UI command containing a BST with new beaconID. 5. Verify IUT is not blocked by the previous erroneous commands, but replies correctly with VST.

TP/LLC/OBU/BI/02	<p>Verify that the OBU can detect and manage an invalid LPDU, containing a fractional number of octets in length.</p> <p>Reference: EN 12795 [1] clause 8.3.5</p> <p>PICS Selection: table A.8/2 AND table A.13/3</p> <p>Initial condition: OBU initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends an ACn command (ECHO.request) with an invalid length of the LPDU that is not an integer multiple of one octet. 2. Verify IUT ignores the received LPDU.
TP/LLC/OBU/BI/03	<p>Verify that the OBU can correctly detect and manage corrupted LLC control fields when an ACn command is expected.</p> <p>Reference: EN 12795 [1] clause 8.3.5</p> <p>PICS Selection: table A.8/2 table A.9/1 AND table A.13/3</p> <p>Initial condition: OBU initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends an ACn command (ECHO.request) with Poll bit set to P=1, but with invalid modifier bits in the LLC control field such, that the LLC control field does not indicate a UI command. 2. Verify IUT ignores the received LPDU. 3. Repeat steps 1 and 2 for all invalid values of the modifier bits. 4. Repeat steps 1 and 2 for all invalid combinations of the reserved bits and with correct setting of the modifier bits. 5. Tester sends a valid ACn command (ECHO.request) with Poll bit set to P=1. 6. Verify IUT is not blocked by the previous erroneous commands, but replies correctly with ACn response (ECHO.response).
TP/LLC/OBU/BI/04	<p>Verify that the OBU can detect and manage an LPDU, containing an acknowledged connectionless LLC command control field when the LID is multicast or broadcast.</p> <p>Reference: EN 12795 [1] clause 8.3.5</p> <p>PICS Selection: table A.8/2 AND table A.13/3</p> <p>Initial condition: OBU initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends an LPDU, containing an ACn command with Poll bit set to P=1, and with broadcast LID. 2. Verify IUT ignores the received LPDU. 3. Repeat steps 1 and 2 for all possible values of a multicast LID instead of the broadcast LID. 4. Repeat step 1 with valid private LID. 5. Verify IUT is not blocked by the previous erroneous commands, but replies correctly.
TP/LLC/OBU/BI/05	<p>Verify that the OBU can detect and manage an invalid LPDU, containing a fractional number of octets in length.</p> <p>Reference: EN 12795 [1] clause 8.3.5</p> <p>PICS Selection: table A.2/2 AND A.8/1</p> <p>Initial condition: OBU not initialized.</p> <p>Stimulus and Expected Behaviour:</p> <ol style="list-style-type: none"> 1. Tester sends UI command carrying a BST with a length that is not an integer multiple of one octet. 2. Verify IUT ignores the received LPDU. 3. Tester sends valid UI command carrying a BST. 4. Verify IUT is not blocked by the previous erroneous frame, but responds correctly with VST.

5.5 LLC test purposes for Road-Side Unit

5.5.1 BV test purposes

Test sub-group objective:

- to test the behaviour of the IUT in relation to syntactically and contextual correct behaviour of the test system.

Test purposes:

TP/LLC/RSU/BV/01	Verify that the RSU can exchange UI commands.
	Reference: EN 12795 [1] clause 8.4.2
	PICS Selection: table B.2/2
	Initial condition: RSU set up to run a complete application.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Verify IUT sends an UI command containing a BST. 2. Tester replies with an UI command containing a VST. 3. Verify IUT correctly acknowledges the VST with a privately addressed frame.
NOTE: The frame expected in step 3. may be any privately addressed frame.	

TP/LLC/RSU/BV/02	Verify that the RSU can manage ACn commands with correct n-value initialization and n-value sequence.
	Reference: EN 12795 [1] clause 8.4.3.1
	PICS Selection: table B.8/2
	Initial condition: Tester initialized with RSU. RSU set up to run an application that needs to send at least three ACn commands.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Verify IUT sends an AC0 command as the first ACn command. 2. Tester replies with an AC1 response. 3. Verify IUT sends an AC1 command as the next ACn command. 4. Tester replies with an AC0 response. 5. Verify IUT sends an AC0 command as the next ACn command.
NOTE: The ACn commands may be either for data transmission or for data exchange.	

TP/LLC/RSU/BV/03	Verify that the RSU can correctly manage the re-transmission of ACn command.
	Reference: EN 12795 [1] clause 8.4.3.3
	PICS Selection: table B.8/2
	Initial condition: Tester initialized with RSU. RSU set up to run an application that requires at least transmission of two ACn commands.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Verify IUT sends an AC0 command as the first ACn command. 2. Tester responds correctly to the AC0 command. 3. Verify IUT sends an AC1 command as second ACn command 4. Verify IUT transmits the same AC1 command N11 times. 5. Verify IUT transmits a new command after N11 transmissions of AC1 command.

TP/LLC/RSU/BV/04	Verify that the RSU can correctly manage multiple link communications.
	Reference: EN 12795 [1] clause 8.4.3.1
	PICS Selection: table B.8/2
	Initial condition: Tester is simulating 3 OBUs. Application in IUT has to exchange at least two ACn messages after initialization with each OBU.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester shall request private uplink windows for all three OBUs simultaneously in the same sequence of public uplink windows. 2. Verify IUT performs correctly the complete transaction consisting of two ACn cycles for every OBU.

TP/LLC/RSU/BV/05	Verify that the RSU can manage late response Procedure I.
	Reference: EN 13372 [3] clause 7.2
	PICS Selection: table F.4/1
	Initial condition: RSU ready for normal operation of an application. Tester already registered, awaiting request for retrieval of data causing late response.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester LLC acknowledges application layer request for data retrieval from the OBU, carried in an ACn command with poll bit set to P=1, with the LLC status subfield value NE_OK, but not providing the requested APDU. In the remaining test the tester shall handle correctly all further requests from the RSU immediately. 2. Observe whether IUT resends the request. If yes, tester shall provide missing APDU in the ACn response. 3. Tester sends PrWRq following the next BST. 4. Verify IUT sends PrWA. 5. Tester sends missing APDU, see step 1, in the allocated private uplink window using a UI-command. 6. Verify IUT accepts this late response and continues with the application.

5.5.2 BI test purposes

Test sub-group objective:

- To check the behaviour of the of the IUT in response to invalid messages and behaviour from the test tool.

Test purposes:

TP/LLC/RSU/BI/01	Verify that the RSU can correctly manage corrupted LLC control fields.
	Reference: EN 12795 [1] clauses 8.4.2.1, 8.3.2.2
	PICS Selection: table B.2/2
	Initial condition: Tester initialized with RSU.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Verify IUT sends an UI command containing a BST. 2. Tester replies with an UI command containing a VST, where the reserved bits in the LLC control field are set to zero. 3. Verify IUT ignores the received LPDU. 4. Repeat steps 1 through 3 for all remaining invalid combinations of the reserved bits. 5. Repeat step 1. 6. Tester replies correctly with UI command containing a VST. 7. Verify IUT acknowledges VST with a privately addressed command.

TP/LLC/RSU/BI/02	Verify that the RSU can detect and manage an invalid ACn LPDU, containing a fractional number of octets in length.
	Reference: EN 12795 [1] clause 5.4, 8.3.5
	PICS Selection: table B.8/2
	Initial condition: Tester initialized with RSU.
	Stimulus and Expected Behaviour: <ol style="list-style-type: none"> 1. Tester sends an invalid LPDU with length different to an integer multiple of one octet. 2. Verify IUT ignores the received LPDU.

TP/LLC/RSU/BI/03	Verify that the RSU can detect and manage an ACn response, not containing a valid response control field.
	Reference: EN 12795 [1] clauses 5.4 and 8.3.5
	PICS Selection: table B.8/2
	Initial condition: Tester initialized with RSU.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Verify IUT sends an AC0 command as the first ACn command. 2. Tester sends an AC1 response, not containing a valid response control field, except for the n-Bit and for the P/F-bit. 3. Verify IUT ignores the received LPDU. 4. Repeat steps 1 through 3 for all missing invalid values of the response control field, but excluding the value which is valid for a UI command.
TP/LLC/RSU/BI/04	Verify that the RSU can detect and manage an ACn response control field with a corrupted ACn response status subfield.
	Reference: EN 12795 [1] clauses 5.4 and .3.5
	PICS Selection: table B.8/2
	Initial condition: Tester initialized with RSU.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Verify IUT sends an AC0 command as the first ACn command. 2. Tester sends an AC1 response with status subfield different to any of the valid values (OK_OK, NE_OK, NR_OK, RS_OK). 3. Verify IUT ignores the received LPDU. 4. Repeat steps 1 through 3 for all missing invalid values of the response status subfield.
TP/LLC/RSU/BI/05	Verify that the RSU can correctly manage an ACn response with invalid sequence number n.
	Reference: EN 12795 [1] clauses 8.4.3.3 8.4.3.6
	PICS Selection: table B.8/2
	Initial condition: Tester initialized with RSU. Value of N11 parameter is greater than 1. No re-transmission at application level.
	Stimulus and Expected Behaviour:
	<ol style="list-style-type: none"> 1. Verify IUT sends an AC0 command as the first ACn command. 2. Tester sends an AC0 response. 3. Verify IUT, after expiry of the acknowledgement timer, retransmits the same AC0 command.

History

Document history		
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