ELECTRONIC FEE COLLECTION AND OTHER APPLICATIONS

CONFORMANCE TESTS TO THE SPECIFICATION FOR INTEROPERABILITY IN THE BEACON - TRANSPONDER TRANSACTION

PUBLIC WORKS, TRANSPORT AND TELECOMMUNICATIONS MINISTRY (MOPTT)

CHILE

VERSION 1.05

JULY 15TH, 2002

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- **Document Number** : ST2
- **Version** : 1.05
- **Status** : Second Version
- **Date of Issue** : July 15th, 2002

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REVISION SUMMARY

REV	ISSUED BY	DATE	DESCRIPTION
0.5	INTEC-RB	30/03/2001	Draft issue under work
0.6	RAPP-JEN	06/06/2001	New test cases added and draft restructured.
0.7	INTEC-RB	26/06/2001	Draft V0.7
0.8	INTEC-RB	21/08/2001	Draft V0.8
1.0	INTEC-RB	22/01/2002	Version 1.0
1.01	INTEC-RB	28/03/2002	Version 1.01
1.05	INTEC-RB	15/07/2002	Version 1.05, Changes introduced: ✓ Footnote 7 modified ✓ Sections 6.2.1.4 and 6.2.1.5 added ✓ Split of concatenated commands in 6.2.2.2.2 and 6.2.2.2.3 ✓ Limits corrected in 6.4.1.3, (step = 9) ✓ 0º C-Temperature case added in 6.9.

TABLE OF CONTENTS

1 SCOPE

The purpose of this document is to specify the test procedures to be performed on the On-Board Equipment (OBE) to certify that the OBE fulfils basic requirements needed to make it interoperable with different Roadside equipment (RSE) for Electronic Fee Collection (EFC) systems in Chile.

The requirements are defined in "Electronic Fee Collection and Other Applications, Specification for Interoperability in the Beacon – Transponder Transaction (Version 1.2, January 21st, 2002)" issued by the Chilean Public Works, Transport and Telecommunications Ministry (MOPTT).

The test procedures in this document provide the means to assess whether an OBE meets these requirements. The level of conformity of an OBE is appraised through a number of "Test Cases", focusing on whether the OBE can complete a transaction under ideal and more severe circumstances, involving lost messages and error recovery.

An independent certification body shall perform the test procedures according to this specification to appraise whether a certain OBE type fulfils the minimum requirements (i.e. the acceptance criteria) stated for each test case.

2 REFERENCED DOCUMENTS

A list of referenced documents follows. Should any of these publications be modified or revised, their latest editions will apply hereto. If inconsistencies exist between documents, standards will take precedence over supplementary industry specifications.

Reference	Identification	Issue	Name or Description
[MOPTT_ST1]		V 1.25, July 15th, 2002	Electronic Fee Collection and Other Applications, Specification for Interoperability in the Beacon - Transponder Transaction, Public Works, Transport and Telecommunications Ministry (MOPTT), CHILE
[CEN_L1]	prEN 12253	2002	Road Traffic and Transport Telematics (RTTT) - Dedicated Short Range Communication (DSRC) – Physical Layer Using Microwawe at 5.8 GHz.
[CEN_L2]	prEN 12795	2002	Road Traffic and Transport Telematics (RTTT) - Dedicated Short Range Communication (DSRC) - DSRC Data Link Layer: Medium Access and Logical Link Control
[CEN_L7]	prEN 12834	2002	Road Traffic and Transport Telematics (RTTT) - Dedicated Short Range Communication (DSRC) - Application Layer
[CEN_PR]	Draft prEN 13372	Revised Draft, 2002	Road Traffic and Transport Telematics (RTTT) - Dedicated Short Range Communication (DSRC) – DSRC Profiles for RTTT Applications.
[ETSI]	EN 300 674	v. 1.1.1 (Feb. 16, 1999)	Electromagnetic compatibility and Radio spectrum Matters (ERM) – Road Transport and Traffic Telematics (RTTT) – Technical characteristics and test methods for data transmission equipment operating in the 5.8 GHz Industrial, Scentific and Medical (ISM) band.
[GSS_2.0]		V 2.0, Feb 1999	Global Specification for Short Range Communication Bosch Telecom GmbH, Alcatel CGA, Combitech Traffic Systems AB
[A1]	TR4001A1: ER9_1.3	June 12, 1999	Interoperable EFC Transaction Using Central Account Based on DSRC By Alcatel, Combitech, Kapsch, CSSI Telematics Application Programme TS4001 A1

3 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

Definition	Explanation
Fast/Slow Data Access	The mechanism for Slow Data Access defined in ref. [GSS_2.0]

Acronym or Abbreviation	Explanation
DSRC	Dedicated Short Range Communication
EAcK	Element Access Key
EFC	Electronic Fee Collection
EID	Element Identification
MMI	Man Machine Interface
MOPTT	"Ministerio de Obras Públicas, Transportes y Telecomunicaciones", Public Works, Transport and Telecommunications Ministry, Chile
OBE	On Board Equipment
RSE	Roadside Equipment
Rx	Reception
Tx	Transmission

4 EQUIPMENT PROVIDED BY SUPPLIER

The supplier shall provide following equipment and documentation.

- OBE personalised according to chapter 4.1, five samples. Samples shall be chosen at random from a normal production line.
- Statement regarding use of slow or fast data access
- Keys used for cryptographic operations
- Users' Manual for the OBE, which shall include instructions how to handle the equipment and may include, detailed information about the protocol functions.

The supplier should also provide personalisation equipment if that ensures effective testing.

4.1 OBE Configuration

4.1.1 OBE Memory

The OBE User Memory is the part of the OBE, which shall be configured during customisation. The OBE memory shall consist of Elements, and the Elements shall consist of Attributes.

Elements

An Element is addressed by means of the Element Identifier or EID. Each Element inside the OBE shall have an EID, unique within the context of the OBE.

Application Elements

The OBE shall contain the Application Elements indicated in Table 4.1.

TABLE 4.1: ELEMENTS IN MOPTT TRANSPONDER

ELEMENT	APPLICATIONCONTEXT MARK	EID	APPLICATION IDENTIFIER (AID)	ACCESS PROTECTION
System Element	(Not applicable)	0	0 (Application Independent)	DES Key
Interoperable EFC	EFC-ContextMark	N1	1 (EFC)	DES Key
Transponder Issuer	EFC-ContextMark	N2	1 (EFC)	DES Key
Parking Management	PM-ContextMark	N3	6 (parking-management)	DES Key
Traffic Probe	Private-ContextMark	N4	29 (private)	DES Key

Attributes

Each Attribute shall be unambiguously addressed by using its Attribute Identifier or AttrID and the EID of the element containing the Attribute. It shall be possible to protect each Attribute against reading and/or writing. Tables 4.2 to 4.6 indicate the Attributes that shall be implemented.

TABLE 4.2: INTEROPERABLE EFC ELEMENT (APPLICATION ID = 1)					
ATTRIBUTE NAME	**ATTRID**	**LENGTH (OCTETS)**	**TYPE**	**ACCESS**	**VALUE TO BE USED IN THE TESTS (HEX)**
EFC-ContextMark	0_{10}	6	Choice 32_{10}	No Direct Access	72 40 40 00 01 01
ContractSerialNumber	1_{10}	4	Choice 33_{10}	Read Only	0F 08 04 01
ContractValidity	2_{10}	6	Choice 34_{10}	Read Only	00 00 01 01 0F AC
ReceiptServicePart	5_{10}	13	Choice 37_{10}	Read/Write	
SessionClass	6_{10}	2	Choice 38_{10}	Read/Write	
ReceiptAuthenticator	13_{10}	5	Choice 45_{10}	Read/Write	
VehicleClass	17_{10}	1	Choice 49_{10}	Read Only	43
EquipmentStatus	26_{10}	2	Choice 58_{10}	Read/Write	00 01
Spare	98_{10}	13	Choice 2_{10}	Read/Write	AA AA AA AA AA AA AA AA AA AA AA AA AA
	KeyRef				
ElementAuthenticationKeyA1	111_{10}	8 (1)		No Access	The Element Authentication Keys shall be calculated as explained in B.2.1, using the MEAuK values given there.
ElementAuthenticationKeyA2	112_{10}	8 (1)		No Access	
ElementAuthenticationKeyF1	113_{10}	8 (1)		No Access	
ElementAuthenticationKeyF2	114_{10}	8 (1)		No Access	
ElementAuthenticationKeyI1	115_{10}	8 (1)		No Access	
ElementAuthenticationKeyI2	116_{10}	8 (1)		No Access	
ElementAuthenticationKeyI3	117_{10}	8 (1)		No Access	
ElementAuthenticationKeyI4	118_{10}	8 (1)		No Access	
ElementAccessKey	120_{10}	8 (1)		No Access	(2)

TABLE 4.3: TRANSPONDER ISSUER ELEMENT (APPLICATION ID = 1)					
ATTRIBUTE NAME	**ATTRID**	**LENGTH (OCTETS)**	**TYPE**	**ACCESS**	**VALUE TO BE USED IN THE TESTS (HEX)**
EFC-ContextMark	0_{10}	6	Choice 32_{10}	No Direct Access	72 40 40 00 02 02
Scratchpad	96_{10}	6	Choice 2_{10}	Read/Write	
ElementAccessKey	120_{10}	8 (1)		No Access	(2)

1 Security algorithms in OBE according to [A1] are of the DES type with 8-byte long keys. If the OBE employs 3-DES security algorithms, the keys will be 16-byte long; in order to keep compatibility with the [A1] specification, the keys shall be defined with identical left and right halves.

2 Key shall be calculated as explained in B.1.1 using the MEAcK value given there.

TABLE 4.4: PARKING MANAGEMENT ELEMENT (APPLICATION ID = 6)					
ATTRIBUTE NAME	ATTRID	LENGTH (OCTETS)	TYPE	ACCESS	VALUE TO BE USED IN THE TESTS (HEX)
PM-ContextMark	0_{10}	6	Choice 32_{10}	No Direct Access	72 40 40 00 03 03
ContractSerialNumber	1_{10}	4	Choice 33_{10}	Read Only	70 0F 08 02
ElementAuthenticationKey	111_{10}	8 (1)		No Access	(3)
ElementAccessKey	120_{10}	8 (1)		No Access	(2)

See note (1) at foot of page 9.

TABLE 4.5: TRAFFIC PROBE ELEMENT (APPLICATION 29)					
ATTRIBUTE NAME	ATTRID	LENGTH (OCTETS)	TYPE	ACCESS	VALUE TO BE USED IN THE TESTS (HEX)
Private-ContextMark	0_{10}	6	Choice 32_{10}	No Direct Access	72 40 40 00 04 04
TemporaryID	97_{10}	3	Choice 2_{10}	Read/Write	
ElementAccessKey	120_{10}	8 (1)		No Access	(2)

See note (1) at foot of page 9.

TABLE 4.6: APPLICATION INDEPENDENT ATTRIBUTES					
ATTRIBUTE NAME	ATTRID	LENGTH (OCTETS)	TYPE	ACCESS	VALUE TO BE USED IN THE TESTS (HEX)
ObeStatus		2	Integer (0...65535)	No Direct Access	
OBEGroupID		2	Integer (0...65535)	No Access	0F D3

4.1.2 OBE Security

The OBE shall be able to perform DES cryptographic operations according to ANSI X3.92. The security functions of the OBE shall be according to Annex B.

The payment transaction shall be secured by:

- Access credentials
- Attribute authentication

4.1.2.1 Element Access

Protected Elements shall be possible to access only when using the right AccessCredentials.

[3] Key shall be calculated as explained in B.2.1, using the MEAuK value given there.

4.1.2.2 Attribute Authentication

It shall be possible to use all the Element Authentication Keys defined in Tables 4.2 to 4.5. For the Interoperable EFC Element, 3 groups of Element Authentication Keys EAuK are used:

- Issuer keys, addressed with KeyRef = KeyRef_A = 111_{10}...112_{10}
- MOPTT keys, addressed with KeyRef = KeyRef_F = 113_{10}...114_{10}
- Interoperable keys, addressed with KeyRef = KeyRef_I = 115_{10}...118_{10}

See Annex B for key derivation.

5 TESTING REQUIREMENTS

5.1 OBE Testbed Environment

Excluding the timing and RF tests, this section shows a specific way in which the OBE Testbed Environment may be implemented.

As shown in Figure 5.1, the OBE Testbed Environment consists of three main parts:

- Test generation Equipment (Layer 7)
- Real-time Beacon Control Equipment (Layer 2)
- Reference Beacon (Layer 1)

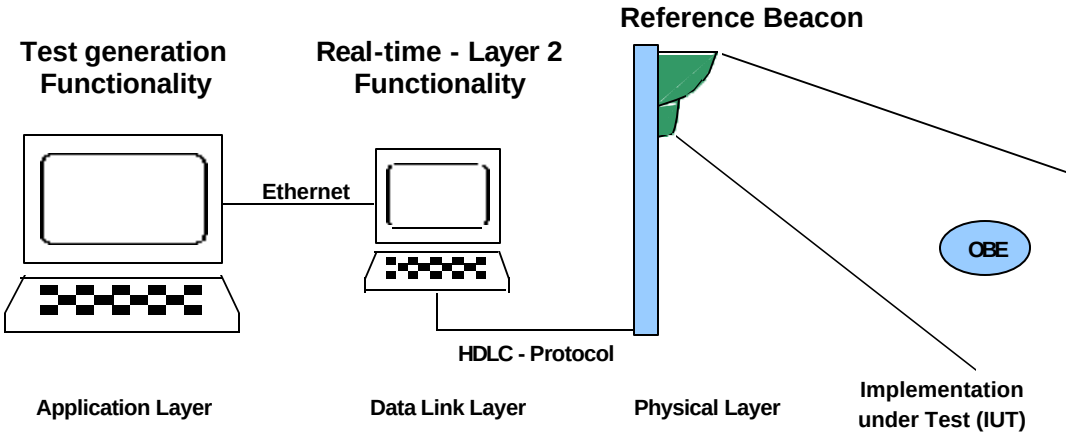

Figure 5.1: OBE Testbed Environment

Each part of the OBE Testbed Environment corresponds to one Layer of the DSRC Protocol.

5.1.1 Functionality of OBE Testbed Environment

This chapter describes the functionality of each part of the OBE Testbed Environment as mentioned in the section before.

5.1.1.1 Functionality of Test Generation Equipment

The Test generation Equipment consists of a PC and a software tool with a graphical user interface. In this software tool the user can select the manufacturer and the test to be performed. After this selection, the test is generated in plain ASCII format and will be retrieved by the Realtime-Beacon-Control-PC via the ftp-protocol. While performing the tests, it is possible to observe the reactions of the OBE under test. These reactions are also written to a file for further examination.

5.1.1.2 Functionality of Realtime-Beacon-Control-Equipment

The Realtime-Beacon-Control-Equipment consists of a PC with an implemented HDLC controller for the control of the reference beacon. Furthermore, a piece of software allows setting the configuration of the HDLC controller and provides the connection to the Test generation Equipment. An interrupt routine handles the sending and reception of frames to and from the reference beacon.

5.1.1.3 Functionality of the Reference Beacon

The reference beacon is a transparent Layer 1 interface. That means, it will only send and receive frames to or from the OBE. There is no intelligence inside this beacon. All intelligence is in the Realtime-Beacon-Control-Equipment. Beacon parameters, e.g. the transmitting power, can be adjusted on a terminal connected through a serial interface to the beacon. On the terminal it is also possible to observe the status of the beacon, e.g. whether it is sending or receiving. The Beacon shall be able to manage both subcarriers specified in [CEN-L1].

5.1.2 RSE configuration - BST parameters

The BST message shall have the parameters indicated in Table 5.1 below, unless otherwise explicitly specified. Chapter C.1.1 in [MOPTT_ST1] accounts for the bit coding of a BST frame.

TABLE 5.1: BST PARAMETERS

PARAMETER	VALUE	NOTE
BeaconID • manufacturerid • individualid	 1 1	Except for test cases : TC04-A: Profile Handling TC04-B: Application Id Handling and TC04-E: Beacon ID handling.
Number of mandatory applications	1	
Number of non-mandatory applications	0	

TABLE 5.1: BST PARAMETERS

PARAMETER	VALUE	NOTE
Application ID	1 (EFC)	Except for test cases : **Reset of "T" Flag in obeStatus** **After executing** test run 12 of 6.2.1.2, the flag "T" in obeStatus shall be reset. **STEP / ACTION / EXPECTED RESPONSE / NOTE** 1. Reset the obeStatus "T" flag, using the procedure specified by the transponder manufacturer. — The me transpo simulat in the v 2. Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received. — PrWRq according to C.1.2 in [MOPTT_ST1] 3. Send PrWA according to C.1.3 in [MOPTT_ST1] — VST according to C.1.4 in [MOPTT_ST1] — Check VST. **5.1.2.1 Acceptance Criteria** **ITEM / ACCEPTANCE CRITERIA / LIMIT / NOTE** 1. obeStatus value — xxxx 0xxx2 ("T" bit = 0) xxxx xxx02 ("R" bit = 0) TC02-B: Normal Parking Management Transaction TC02-C: Normal Traffic Probe Transaction and TC04-B: Application Id Handling.
Profile	0	Except for test cases: TC04: DSRC Connection Functionality TC04-A: Profile Handling.

5.1.3 Conformance Testing with the OBE Testbed Environment

In the development of the test generation software the [MOPTT_ST1] specification[4] is to be taken into account. This means that the tests correspond directly to the [MOPTT_ST1 specification and the result of the tests are related to the implemented software within the OBE. That makes it possible to decide if the OBE works according to these standards for the tests performed.

The tests to be performed with this reference beacon are not meant to observe all choices given by the DSRC protocol. Instead, they test the main functionality and some special conditions as required by the MOPTT.

5.2 Test Result Documentation

The complete test report documentation shall be divided into three parts, in order to facilitate the reading. It shall give the reader a comprehensive summary of the test result, and it shall also describe in detail how the test was performed and what kind of

4 [MOPTT_ST1] references CEN standards, GSS and A1 specifications.

test equipment was used. For each test procedure step a verdict shall be given whether the equipment under test passed, undecided [5] or failed. Detailed data must be recorded after each test procedure step in order to prove whether the equipment under test passed, undecided or failed.

5.2.1 Summary of Test Result

The Summary of Test Result shall briefly describe the test result including any uncertainties and/or deviations from expected result.

5.2.2 Description of Test Methods and Test Set-up

The Test Method associated with each specified test case shall be described. Also the test equipment used shall be specified.

5.2.3 Detailed Test Result and Test Data

For each test case it shall be stated whether the equipment under test passed, undecided or failed to perform the specified function(s) and gave the expected response. For test cases concerning "fast data access" and "slow data access" only one of them is applicable.

In addition to the test result, for each test case additional detailed test data shall be recorded and made available, to prove the statement of the test result.

[5] An inconclusive verdict ought never be the final verdict but may at an exceptional case be an intermediate result, whilst a further investigation is pursued in order to clarify the source of an observed phenomenon.

6 TEST CASES

Table 6.1 below provides an overview of the test cases (TC): the objective, test id, test name and remarks.

TABLE 6.1: OVERVIEW OF THE TEST CASES

OBJECTIVE	TEST ID	TEST NAME	REMARKS
Specification conformance	TC01-A	Conformity Statement to MOPTT Specification	
Application – Basic Functionality [6]	TC02-A	Interoperable EFC Transaction	
	TC02-B	Parking Management Transaction	
	TC02-C	Traffic Probe Transaction	
Application – Security functions	TC03-A	Access rights – Security Functions: GET and SET with wrong access credentials	The correct cases are verified under TC02.
	TC03-B	Security Functions: Element authentication	
DSRC (L7) Connection Functionality	TC04-A	Profile handling	
	TC04-B	Application Id handling	
	TC04-C	Release handling	
	TC04-D	Time handling	
	TC04-E	Beacon ID handling	
DSRC – Connection Recovery	TC05-A	Connection recovery: PrWRq lost	
	TC05-B	Connection recovery: First Private DL-Frame or VST lost	
DSRC – ACn Recovery	TC06-A	Fast access recovery functions: GET/SET-Res lost	TC06-A [6]
	TC06-B	Slow access recovery functions: GET/SET-Res lost	TC06-B [6]
DSRC – communication Blocked recovery	TC07-A	Communication blocked	
	TC07-B	Communication blocked: 300 s	
DSRC (L2 MAC) Performance	TC08-A	PuW timing	
	TC08-B	PrW timing	
	TC08-C	Uplink to downlink turn around – OBE Tx to Rx mode	
DSRC RF Properties	TC09-A	OBE sensitivity	Affects the effective communication zone
	TC09-B	Conversion gain	
	TC09-C	OBE spurious emissions	Affects the interference level

The test cases are defined in the subsequent chapters. Testing applies as the verification method for all TCs except for TC01-a, for which document inspection applies.

For tests specified in sections 6.1 through 0, unless otherwise indicated, the time between each step shall be less than 100 ms, in order to prevent the OBE from entering the sleep state.

Unless otherwise explicitly specified, every test shall be repeated 10 times and with the mechanism used to detect transponder removal simulating that the transponder is mounted on a vehicle. Some test cases can be repeated without waiting if the Beacon ID is changed.

[6] The supplier shall state whether the OBE under test makes use of slow or fast data access. Depending upon this either TC06-A (fast access) or TC06-B (slow access) shall be executed.

6.1 TC01: Specification Conformance

6.1.1 TC01-A: Statement Regarding Conformity to MOPTT specification

The purpose of this inspection is that the supplier shall state that their OBE conforms to MOPTT's Specification for Interoperability [MOPTT_ST1].

6.1.1.1 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Conformity statement to MOPTT Specification [MOPTT_ST1].	Availability of the Conformity statement according to Annex A	A copy of the statement shall be included in the test report

6.2 TC02: Application – Basic Functions

6.2.1 TC02-A: Normal Interoperable EFC Transaction

The purpose of this test is to verify the data flow and timing of a perfect transaction without any retransmission or any another disturbances. This test shall be repeated 12 times.

6.2.1.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.2.1.2 Main Execution Steps

The test case below is divided into four parts. Parts A and D are the same for all types of OBEs. One of parts B and C shall be selected based upon whether the OBE makes use of slow access or not. The test case shall be executed as one continuous transaction in the sequence ABD or ACD.

6.2.1.2.1 Part A: Initialisation Phase

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1]	For runs 11 & 12: mechanism used to detect transponder removal shall simulate transponder has been removed from vehicle.
2.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.4 in [MOPTT_ST1]	For Runs 1 to 10: Verify that flags "T" and "R" in obeStatus included in the VST are reset. For runs 11 & 12: Verify that flags "T" and "R" in obeStatus included in the VST are set.

6.2.1.2.2 Part B: Transaction Core, Fast Data Access Mode

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n1, with AccessCredentials, for attributes 1, 2, 5, 6, 13, 17, 98) according to C.2.1 in [MOPTT_ST1].	ACn(GetStamped Action-Response concatenated with GET-Response) according to to C.2.2 in [MOPTT_ST1].	The parameter KeyRef shall be as follows: 111 (runs 1 & 2), 112 (runs 3 & 4), 115 (runs 5 & 6), 116 (runs 7 & 8), 117 (runs 9 & 10), 118 (runs 11 & 12)
3.1	Send the BST, configured according to step 1.	None	
4.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n2, with AccessCredentials, for attribute 96, concatenated with a Get-Request, EID = 0, with AccessCredentials, for Requested attribute[7]) according to C.2.5 in [MOPTT_ST1].	ACn(GetStamped Action-Response, concatenated with GET-Response, concatenated with GET-Response) according to C.2.6 in [MOPTT_ST1].	The parameter KeyRef shall be as follows: 113 (runs 1, 2 & 3), 114 (runs 4, 5 & 6), 111 (runs 7, 8 & 9), 112 (runs 10, 11 & 12)
4.1	Send the BST, configured according to step 1.	None	
5.	Send an ACn(SET-Request, EID = n1, with AccessCredentials, for attributes 5, 6, 13, 26, 98 with new data compared to step 3, concatenated with a SET-Request, EID = n2, with AccessCredentials, for attribute 96 with new data compared to step 4, concatenated with an Action-Request ActionType = SET-MMI(0,1,2)) according to C.2.8 in [MOPTT_ST1].	ACn(SET-Response, concatenated with SET-Response, concatenated with SET-MMI Action-Response) according to C.2.9 in [MOPTT_ST1].	The parameter for SET-MMI shall be as follows: 0 (runs 1, 2, 3 & 4), 1 (runs 5, 6, 7 & 8), 2 (runs 9, 10, 11 & 12)
5.1	Send the BST, configured according to step 1.	None	

[7] Requested attribute is any readable attribute within the System Element. The last concatenated GET-Request command shall be executed only if the System Element contains at least one readable attribute. The transponder manufacturer shall indicate how this element can be accessed.

6.2.1.2.3 Part C: Transaction Core, Slow Data Access Mode

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n1, with AccessCredentials, for attributes 1, 2, 5, 6, 13, 17, 98) according to C.2.1 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	The parameter KeyRef shall be as follows: 111 (runs 1 & 2), 112 (runs 3 & 4), 115 (runs 5 & 6), 116 (runs 7 & 8), 117 (runs 9 & 10), 118 (runs 11 & 12)
3.1	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received.
3.2	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(GetStamped Action-Response concatenated with GET-Response) according to C.2.3 in [MOPTT_ST1].	
4.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n2, with AccessCredentials, for attribute 96, concatenated with a Get-Request, EID = 0, with AccessCredentials, for Requested attribute [7]) according to C.2.5 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	The parameter KeyRef shall be as follows: 113 (runs 1, 2 & 3), 114 (runs 4, 5 & 6), 111 (runs 7, 8 & 9), 112 (runs 10, 11 & 12) (See note (7) on page 17)
4.1	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
4.2	Send PrWA according to C.1.3 in [MOPTT_ST1].	(GetStamped Action-Response, concatenated with GET-Response, concatenated with GET-Response) according to C.2.7 in [MOPTT_ST1].	
5.	Send an ACn(SET-Request, EID = n1, with AccessCredentials, for attributes 5, 6, 13, 26, 98 with new data compared to step 3, concatenated with a SET-Request, EID = n2, with AccessCredentials, for attribute 96 with new data compared to step 4, concatenated with an Action-Request ActionType = SET-MMI(0,1,2)) according to C.2.8 in [MOPTT_ST1].	Acn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	The parameter for SET-MMI shall be as follows: 0 (runs 1, 2, 3 & 4), 1 (runs 5, 6, 7 & 8), 2 (runs 9, 10, 11 & 12)
5.1	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
5.2	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(SET-Response, concatenated with SET-Response, concatenated with a SET-MMI Action-Response) according to C.2.10 in [MOPTT_ST1].	

6.2.1.2.4 Part D: End of Transaction, Tracking and Closing Phase

STEP	ACTION	EXPECTED RESPONSE	NOTE
6.	Send an Acn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	Acn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
7.	Send the BST, configured according to step 1.	None	
8.	Send an Acn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	Acn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
9.	Send the BST, configured according to step 1.	None	
10.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1].	None	
11.	Send an UI(EVENT_REPORT -Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1].	None	

All observed anomalies, problems and unusual events during execution of the test shall be noted.

1. The time from start of the down link frame until the end of the uplink frame, in step 3 for fast data access and 3 to 3.2 for slow data access, shall be noted in the test report. The same applies for steps 4 and 5.
2. It shall be stated in the test report whether the OBE makes use of slow data or not.

6.2.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.2.1.2.	If a retransmission occurs during the test, the test shall be restarted
2.	Frame data content	According to C in [MOPTT_ST1].	
3.	MMI signalling	1. Successful (4 times) 2. Not successful (4 times) 3. Contact Operator (4 times)	

6.2.1.4 Reset of "T" Flag in obeStatus

After executing test run 12 of 6.2.1.2, the flag "T" in obeStatus shall be reset.

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Reset the obeStatus "T" flag, using the procedure specified by the transponder manufacturer.		The mechanism used to detect transponder removal shall be set to simulate that the transponder is installed in the vehicle.
2.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1]	
3.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.4 in [MOPTT_ST1]	Check obeStatus value included in the VST.

6.2.1.5 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	obeStatus value	xxxx $0xxx_2$ ("T" bit = 0) xxxx $xxx0_2$ ("R" bit = 0)	

6.2.2 TC02-B: Normal Parking Management Transaction

The purpose of this test is to verify the data flow and timing of a perfect transaction without any retransmission or any another disturbances.

6.2.2.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.2.2.2 Main Execution Steps

The test case below is divided into four parts. Parts A and D are the same for all types of OBEs. One of parts B and C shall be selected based upon whether the OBE makes use of slow access or not. The test case shall be executed as one continuous transaction in the sequence ABD or ACD.

6.2.2.2.1 Part A: Initialisation Phase

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2 except for the Aid, which shall be set to 6 (=Parking Management). Chapter C.1.1 in [MOPTT_ST1] accounts for the bit coding of a BST frame. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.5 in [MOPTT_ST1]	

6.2.2.2.2 Part B: Presentation and Receipt Phases, Fast Data Access Mode

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n3, with AccessCredentials, for attribute 1) according to C.3.1 in [MOPTT_ST1].	ACn(GetStamped Action-Response concatenated with a SET-MMI Action-Response) according to C.3.1 in [MOPTT_ST1].	
3.1	Send the BST, configured according to step 1.	None	
3.2	Send an ACn(Action-Request ActionType = SET-MMI(OK)) according to C.3.4 in [MOPTT_ST1]	ACn(SET-MMI Action-Response) according to C.3.5 in [MOPTT_ST1].	
3.3	Send the BST, configured according to step 1.	None	

6.2.2.2.3 Part C: Presentation and Receipt Phases, Slow Data Access Mode

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n3, with AccessCredentials, for attribute 1) according to C.3.1 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	
3.1	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received.
3.2	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(GetStamped Action-Response) according to C.3.3 in [MOPTT_ST1].	
3.3	Send an ACn(Action-Request ActionType = SET-MMI(OK)) according to C.3.4 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	
3.4	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received.
3.5	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(SET-MMI Action-Response) according to C.3.6 in [MOPTT_ST1].	

6.2.2.2.4 Part D: Closing Phase

STEP	ACTION	EXPECTED RESPONSE	NOTE
4.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1].	None	
5.	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	

All observed anomalies, problems and unusual events during execution of the test shall be noted.

1. The time from start of the down link frame until the end of the uplink frame, in step 3 for fast data access and 3 to 3.2 for slow data access, shall be noted in the test report.
2. It shall be stated in the test report whether the OBE makes use of slow data or not.

6.2.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.2.2.2	If a retransmission occurs during the test, the test shall be restarted
2.	Frame data content	According to Annex C in [MOPTT_ST1]	

6.2.3 TC02-C: Normal Traffic Probe Transaction

The purpose of this test is to verify the data flow and timing of a perfect transaction without any retransmission or any another disturbances.

6.2.3.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.2.3.2 Main Execution Steps

The test case below is divided into four parts. Parts A and D are the same for all types of OBEs. One of parts B and C shall be selected based upon whether the OBE makes use of slow access or not. The test case shall be executed as one continuous transaction in the sequence ABD or ACD.

6.2.3.2.1 Part A: Initialisation Phase

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2 except for the Aid, which shall be set to 29 (=Traffic Probe Management). Chapter C.1.1 in [MOPTT_ST1] accounts for the bit coding of a BST frame. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.5 in [MOPTT_ST1].	

6.2.3.2.2 Part B: Presentation and Update Phases, Fast Data Access Mode

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.	Send an ACn(Get-Request, EID = n4, with AccessCredentials, for attribute 97) according to C.4.1 in [MOP TT_ST1].	ACn(Get-Response) according to C.4.2 in [MOPTT_ST1].	
3.1	Send the BST, configured according to step 1.	None	
4.	Send an ACn(Set-Request, EID = n4, with AccessCredentials, for attribute 97, with new data compared to step 3) according to C.4.4. in [MOPTT_ST1].	ACn(Set-Response) according to C.4.5 in [MOPTT_ST1].	
4.1	Send the BST, configured according to step 1.	None	

6.2.3.2.3 Part C: Presentation and Update Phases, Slow Data Access Mode

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.	Send an ACn(Get-Request, EID = n4, with AccessCredentials, for attribute 97) according to C.4.1 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	
3.1	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received.
3.2	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(Get-Response) according to C.4.3 in [MOPTT_ST1].	
4.	Send an ACn(Set-Request, EID = n4, with AccessCredentials, for attribute 97, with new data compared to step 3) according to C.4.4 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	
4.1	Send the BST, configured according to step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received.
4.2	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(Set-Response) according to C.4.6 in [MOPTT_ST1].	

6.2.3.2.4 Part D: Closing Phase

STEP	ACTION	EXPECTED RESPONSE	NOTE
4.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1].	None	
5.	Send the BST, configured according to step 1.	None	

All observed anomalies, problems and unusual events during execution of the test shall be noted.

1. The time from start of the down link frame until the end of the uplink frame, in step 3 for fast data access and 3 to 3.2 for slow data access, shall be noted in the test report.
2. It shall be stated in the test report whether the OBE makes use of slow data or not.

6.2.3.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.2.3.2	If a retransmission occurs during the test, the test shall be restarted
2.	Frame data content	According to Annex C in [MOPTT_ST1].	

6.3 TC03: Application – Security Functions

6.3.1 TC03-A: GET and SET with wrong AccessCredentials

The purpose of this test is to verify the OBE behaviour when using wrong AccessCredentials.

6.3.1.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment be placed in such a way that optimal communication can be foreseen.

6.3.1.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Run the complete "Normal Transaction" according to test case TC02-A but the AccessCredentials shall be calculated with a wrong key.		

6.3.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	GET-Res frame data content	The GET-Res frame shall not contain any attribute data from the OBE	
2.	OBE attribute data	Verify that the attribute data in the OBE has not changed after the test	

6.3.2 TC03-B: Element Authentication

The purpose of this test is to verify the OBE behaviour when changing the RndRSE value.

6.3.2.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.3.2.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Run the complete "Normal Transaction" according to test case TC02-A with different RND RSE every time.	Normal transaction	

6.3.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	GET-Stamped.res(authenticator)	Authenticators calculated by the OBE & RSE shall be equal.	

6.4 TC04: DSRC Connection Functionality

6.4.1 TC04-A: Profile Handling

The purpose of this test is to verify correct handling of the profile parameter. This functionality is important when an OBE is passing an RSE of an incompatible system (i.e. not conforming to MOPTT's 5.8 DSRC specification) in order to ensure non-detrimental co-existence of non-compatible system.

6.4.1.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.4.1.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1]	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.4 in [MOPTT_ST1]. Profile = P0, fs = 1.5 MHz	
3.	Same as in step 1 except for Profile (=Profile 1) and individualid (=2).	PrWRq according to C.1.2 in [MOPTT_ST1]	
4.	Same as in step 2.	VST according to C.1.4 in [MOPTT_ST1]. Profile = P1, fs = 2.0 MHz	
5.	Same as in step 1 except for Profile = Multiprofiles (Profile 0, Profile 9) and individualid (=3).	PrWRq according to C.1.2 in [MOPTT_ST1]	Profile = Multiprofiles (Profile 0, Profile 9) means that Profile = Profile 0 and ProfileList = Profile 9
6.	Same as in step 2.	VST according to C.1.4 in [MOPTT_ST1]. Profile = P0, fs = 1.5 MHz	
7.	Same as in step 1 except for Profile = Multiprofiles (Profile 1, Profile 8) and individualid (=4).	PrWRq according to C.1.2 in [MOPTT_ST1]	Profile = Multiprofiles (Profile 1, Profile 8) means that Profile = Profile 1 and ProfileList = Profile 8
8.	Same as in step 2.	VST according to C.1.4 in [MOPTT_ST1]. Profile = P1, fs = 2.0 MHz	
9.	Same as in step 1 except for Profile = Multiprofiles (Profile 2, Profile 8) and individualid (=5).	None	Profile = Multiprofiles (Profile 2, Profile 8) means that Profile = Profile 2 and ProfileList = Profile 8

6.4.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Profile	P0 in steps 2 and 6 P1 in steps 4 and 8 None in step 9	
2.	Sub-carrier frequency	fs = 1.5 MHz steps 2 and 6 fs = 2.0 MHz steps 4 and 8 None in step 9	

6.4.2 TC04-B: Application Id Handling

The purpose of this test is to verify the correct handling of the AID parameter.

6.4.2.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.4.2.2 Main Execution Steps

The attempt to execute the initialisation phase shall terminate upon one successful completion or after 1000 BSTs have been transmitted and no response from the OBE.

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2 except for Aid, which shall be equal to 4 (=TTI). Send BST every (5-10) ms until an uplink frame is received.	None	Execute an initialisation sequence and note which Aid is contained in the VST transmitted by the OBE.
2.	Same as in step 1 except that Aid = (EFC, TTI) and individualid (=2)	PrWRq according to C.1.2 in [MOPTT_ST1].	
3.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.4 in [MOPTT_ST1]. Aid=1.	
4.	Same as in step 1 except that Aid = (TTI, EFC) and individualid (=3)	PrWRq according to C.1.2 in [MOPTT_ST1].	
5.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.4 in [MOPTT_ST1]. Aid=1.	
6.	Same as in step 2.	Aid = EFC	

6.4.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Aid	None in step 1 Aid =1 (=EFC) in steps 3 & 6	

6.4.3 TC04-C: Release Handling

The purpose of this test is to verify if a roadside can release the OBE.

6.4.3.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.4.3.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1]	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1]	VST according to C.1.4 in [MOPTT_ST1]	
3.	Send an UI(EVENT_REPORT-Request, without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1]. Repeat 2 times with 5-10 ms between the UI frames.	None	Since the Release command is non-acknowledged no response is received by the RSE.
4.	Send the BST, configured according to step 1.	None	If a frame is received, then investigate whether the Release command was indeed received by the OBE.

6.4.3.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.4.3.2	If a retransmission occurs during the test, the test shall be restarted

6.4.4 TC04-D: Time Handling

The purpose of this test is to verify that the correct handling of the BST time by the OBE, and that the OBE does not answer to the same RSE after complete transaction.

6.4.4.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.4.4.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
3.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1]. Repeat 2 times with 5-10 ms between the UI frames.	None	Since the Release command is non-acknowledged no response is received by the RSE.
4.	Send the BST, configured according to step 1, every (5-10) ms for 100 s.	None	If a frame is received, then investigate whether the Release command was indeed received by the OBE.
5.	Send no BST for 100 s.	None	
6.	Send the BST, configured according to step 1, every (5-10) ms for 100 s.	None	

6.4.4.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.4.4.2	Only 1 transaction shall be completed.

6.4.5 TC04-E: Beacon ID handling

The purpose of this test is to verify that the OBE connects to the same RSE when manufacturerid or individualid of BeaconID is changed.

6.4.5.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.4.5.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
3.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1]. Repeat 2 times with 5-10 ms between the UI frames.	None	Since the Release command is non-acknowledged no response is received by the RSE.
4.	Configure the BST according to 5.1.2 except for individualid , which shall be set to 2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	Since the Release command places the OBE in Blocked state, response will be delayed about 3 seconds.
5.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
6.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1]. Repeat 2 times with 5-10 ms between the UI frames.	None	Since the Release command is non-acknowledged no response is received by the RSE.
7.	Send the BST, configured according to step 1. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	Since the Release command places the OBE in Blocked state, response will be delayed about 3 seconds.
8.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	

6.4.5.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.4.5.2	If a retransmission occurs during the test, the test shall be restarted

6.5 TC05: DSRC Connection Recovery

6.5.1 TC05-A: Recovery of lost Private Window Requests

The purpose of this test is to verify the OBE behaviour when Private Window Request (PrWRq) is not successfully received by the RSE.

6.5.1.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.5.1.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received. This step is repeated 4 times (i.e. simulating 5 lost PrWRq/PrWA)	PrWRq according to C.1.2 in [MOPTT_ST1].	RSE shall ignore 4 PrWRq frames
2.	Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
3.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	

6.5.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.5.1.2	

6.5.2 TC05-B: Recovery of Lost First Private DL Frame or VST

The purpose of this test is to verify the OBE behaviour after that it has sent the VST message.

6.5.2.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.5.2.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received. This step is repeated 4 times (i.e. simulating 5 lost PrWRq/PrWA)	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	RSE shall ignore uplink frame.
3.	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	
4.	Send PrWA according to C.1.3 in [MOPTT_ST1]. This step is repeated 2 times (i.e. simulating 3 lost VST)	VST according to C.1.4 in [MOPTT_ST1].	
5.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
6.	Same as in step 1.	None	

6.5.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.5.2.2	

6.6 TC06: DSRC ACn Recovery

6.6.1 TC06-A: Fast Access Recovery Functions: GET/SET-Res lost

The purpose of this test is to verify the OBE behaviour in case of lost Get-Response.

6.6.1.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.6.1.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
3.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n1, with AccessCredentials, for attributes 1, 2, 5, 6, 13, 17, 98) according to C.2.1 in [MOPTT_ST1].	ACn(GetStamped Action-Response concatenated with GET-Response) according to C.2.2. in [MOPTT_ST1].	Shall be ignored by the RSE
3.1	Same as in step 1.	None	
3.2	Retransmit the ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n1, with AccessCredentials, for attributes 1, 2, 5, 6, 13, 17, 98) according to C.2.1 in [MOPTT_ST1].	ACn(GetStamped Action-Response concatenated with GET-Response) according to C.2.2. in [MOPTT_ST1].	
4.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n2, with AccessCredentials, for attribute 96, concatenated with a Get-Request, EID = 0, with AccessCredentials, for Requested attribute (7)) according to C.2.5 in [MOPTT_ST1].	ACn(GetStamped Action-Response, concatenated with GET-Response, concatenated with GET-Response) according to C.2.6 in [MOPTT_ST1]	Shall be ignored by the RSE. (See note (7) on page 17)
4.1	Same as in step 1.	None	
4.2	Retransmit the ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n2, with AccessCredentials, for attribute 96, concatenated with a Get-Request, EID = 0, with AccessCredentials, for Requested attribute (7)) according to C.2.5. in [MOPTT_ST1].	ACn(GetStamped Action-Response, concatenated with GET-Response, concatenated with GET-Response) according to C.2.6. in [MOPTT_ST1].	(See note (7) on page 17)
5.	Send an ACn(SET-Request, EID = n1, with AccessCredentials, for attributes 5, 6, 13, 26, 98 with new data compared to step 3, concatenated with a SET-Request, EID = n2, with AccessCredentials, for attribute 96 with new data compared to step 4, concatenated with an Action-Request ActionType = SET-MMI(OK)) according to C.2.8. in [MOPTT_ST1].	ACn(GET-Response, concatenated with GET-Response, concatenated with SET-MMI Action-Response) according to C.2.9. in [MOPTT_ST1].	Shall be ignored by the RSE

STEP	ACTION	EXPECTED RESPONSE	NOTE
5.1	Same as in step 1.	None	
5.2	Retransmit the ACn(SET-Request, EID = n1, with AccessCredentials, for attributes 5, 6, 13, 26, 98 with new data compared to step 3, concatenated with a SET-Request, EID = n2, with AccessCredentials, for attribute 96 with new data compared to step 4, concatenated with an Action-Request ActionType = SET-MMI(OK)) according to C.2.8. in [MOPTT_ST1].	ACn(GET-Response, concatenated with GET-Response, concatenated with SET-MMI Action-Response) according to C.2.9. in [MOPTT_ST1].	

6.6.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.6.1.2	If unintentional retransmission occurs during the test, the test shall be restarted

6.6.2 TC06-B: Slow Access Recovery Functions: GET/SET-Res lost

The purpose of this test is to verify OBE behaviour in case of lost GET/SET-Response.

6.6.2.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.6.2.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
3.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n1, with AccessCredentials, for attributes 1, 2, 5, 6, 13, 17, 98) according to C.2.1 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4 in [MOPTT_ST1].	The RSE shall ignore the Uplink frame
3.1	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
3.2	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n1, with AccessCredentials, for attributes 1, 2, 5, 6, 13, 17, 98) according to C.2.1 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4. in [MOPTT_ST1].	
3.3	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
3.4	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(GetStamped Action-Response concatenated with GET-Response) according to C.2.3. in [MOPTT_ST1].	The RSE shall ignore the Uplink frame
3.5	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	

STEP	ACTION	EXPECTED RESPONSE	NOTE
3.6	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(GetStamped Action-Response concatenated with GET-Response) according to C.2.3. in [MOPTT_ST1].	
4.	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n2, with AccessCredentials, for attribute 96, concatenated with a Get-Request, EID = 0, with AccessCredentials, for Requested attribute [7]) according to C.2.5. in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4. in [MOPTT_ST1].	The RSE shall ignore the Uplink frame. (See note (7) on page 17)
4.1	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
4.2	Send an ACn(Action-Request ActionType = Get-Stamped, EID = n1, with AccessCredentials, for attribute 26, concatenated with a Get-Request, EID = n2, with AccessCredentials, for attribute 96, concatenated with a Get-Request, EID = 0, with AccessCredentials, for Requested attribute [7]) according to C.2.5 in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4. in [MOPTT_ST1].	(See note (7) on page 17)
4.3	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
4.4	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(GetStamped Action-Response, concatenated with GET-Response, concatenated with GET-Response) according to C.2.7 in [MOPTT_ST1].	The RSE shall ignore the Uplink frame
4.5	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	
4.6	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(GetStamped Action-Response, concatenated with GET-Response, concatenated with GET-Response) according to C.2.7 in [MOPTT_ST1].	
5.	Send an ACn(SET-Request, EID = n1, with AccessCredentials, for attributes 5, 6, 13, 26, 98 with new data compared to step 3, concatenated with a SET-Request, EID = n2, with AccessCredentials, for attribute 96 with new data compared to step 4, concatenated with an Action-Request ActionType = SET-MMI(OK)) according to C.2.8. in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4. in [MOPTT_ST1].	The RSE shall ignore the Uplink frame
5.1	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
5.2	Send an ACn(SET-Request, EID = n1, with AccessCredentials, for attributes 5, 6, 13, 26, 98 with new data compared to step 3, concatenated with a SET-Request, EID = n2, with AccessCredentials, for attribute 96 with new data compared to step 4, concatenated with an Action-Request ActionType = SET-MMI(OK)) according to C.2.8. in [MOPTT_ST1].	ACn (LLC-status = NE_OK) according to C.2.4.in [MOPTT_ST1].	
5.3	Same as in step 1.	PrWRq according to C.1.2 in [MOPTT_ST1].	Continue to send BST every 5 ms until a PrWRq is received
5.4	Send PrWA according to C.1.3 in [MOPTT_ST1].	UI(SET-Response, concatenated with SET-Response, concatenated with SET-MMI Action-Response) according to C.2.10 in [MOPTT_ST1]	The RSE shall ignore the Uplink frame

STEP	ACTION	EXPECTED RESPONSE	NOTE
6.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
7.	Same as in step 1.	None	
8.	Send an UI(EVENT_REPORT-Request without AccessCredentials, mode = 0, eventType = RELEASE) according to C.5.3 in [MOPTT_ST1].	None	

6.6.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.6.2.2	If a retransmission occurs during the test, the test shall be restarted
2.	Frame data content	According to Annex C in [MOPTT_ST1].	

6.7 TC07: DSRC Communication – Blocked Recovery

6.7.1 TC07-A: Communication Blocked - Recovery

The purpose of this test is to verify the OBE behaviour after a short time of blocked communication (50 ms, 200 ms and 200 s).

6.7.1.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.7.1.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
3.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2. in [MOPTT_ST1].	
4.	Wait 50 ms		
5.	Send BST 3 times, configured according to step 1.	None	
6.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
7. 8.	Wait 200 ms Send BST 3 times, configured according to step 1.	None	
9.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
10.	Wait 200 s		

STEP	ACTION	EXPECTED RESPONSE	NOTE
11.	Send BST 3 times, configured according to step 1.	None	
12.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	

6.7.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.7.1.2	If a retransmission occurs during the test, the test shall be restarted

6.7.2 TC07-B: Communication Blocked (300 s) – New connection

The purpose of this test is to verify the OBE behaviour after a medium long time of blocked communication. This test shall be executed only 2 times.

6.7.2.1 Equipment and Set-up

The test set-up shall be according to what is described in 5.1.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.7.2.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	
3.	Send an ACn(Action-Request without AccessCredentials, Action Type = echo(length = 0)) according to C.5.1 in [MOPTT_ST1].	ACn(Echo Action-Response) according to C.5.2 in [MOPTT_ST1].	
4.	Wait 300 s		
5.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	
6.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	

6.7.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	Frame sequence	According to 6.7.2.2	If a retransmission occurs during the test, the test shall be restarted

6.8 TC08: DSRC Performance

6.8.1 TC08-A: Timing for Public Windows

The purpose of this test is to verify the correct start and stop of OBE transmissions in public uplink windows.

6.8.1.1 Equipment and Set-up

The test set-up shall be similar to what is described in 5.1, enhanced in order to measure time intervals in the range of 150 µs to 1600 µs.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.8.1.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1] in one of the three public windows.	A detector shall measure the time from the last bit of the RSE stop flag till the first bit of received OBE start flag, and from there to the last bit of the received OBE stop flag. Note the time for start of received OBE frame (including preamble) and end of received OBE frame (i.e. the last bit of the layer 2 end flag) relative to RSE frame end.
2.	Repeat 10 times step 1.		If timing is evaluated automatically, repeat 999 times.
3.	Modify the initialisation sequence so that the guard time after the BST (length T3) is completely filled with random bits. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1] in one of the three public windows.	Note the time for start of received OBE frame (including preamble) and end of received OBE frame (i.e. the last bit of the layer 2 end flag) relative to RSE frame end.
4.	Repeat 10 times step 3		If timing is evaluated automatically, repeat 999 times.

All observed anomalies, problems and unusual events during execution of the test shall be noted.

6.8.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	OBE transmissions in public uplink windows.	According to Table 6.2	Verify that all received frames within public uplink windows are within the limits. The effect of the presence of load frames and extra flags shall be reported. Note that all timing above is relative to the last bit of the stop flag of the BST, and must be corrected because timing is measured relative to last bit of start flag.

Public uplink windows are here numbered #1, #2 and #3, meaning 1st, 2nd and 3rd public uplink window following the BST, respectively.

Table 6.2: Public Up-link Window Timing Limits

Window	Start time	End time
#1	T3 < t < T3 + T4b (160 µs < t < 192 µs)	t < T3 + T5 (t < 608 µs)
#2	T3 + T5 < t < T3 + T5 + T4b (608 µs < t < 640 µs)	t < T3 + 2·T5 (t < 1056 µs)
#3	T3 + 2·T5 < t < T3 + 2·T5 + T4b (1056 µs < t < 1088 µs)	t < T3 + 3·T5 (t < 1504 µs)

NOTE:

For technical reasons, all timing measurements may be made with a device in the RSE detecting the last bit of flag sequences, given that the measured timings can be corrected with the known duration of frame elements to give the timing values referred to the timing reference points defined in 7.3.4 in [CEN_L2].

6.8.2 TC08-B: Timing for private uplink windows

The purpose of this test is to verify the correct start and stop of several private uplink window transmissions.

6.8.2.1 Equipment and Set-up

The test set-up shall be similar to what is described in 5.1, enhanced in order to measure time intervals in the range of 150 µs to 6000 µs.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.8.2.2 Main Execution Steps

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	A detector shall measure the time from the last bit of the RSE stop flag till the first bit of received OBE start flag, and from there to the last bit of the received OBE stop flag.
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1]. The VST frame shall in all cases be within the time windows, measured from the last bit of the RSE stop flag.	Note the time for start of received VST frame (including preamble) and end of received VST frame (i.e. the last bit of the layer 2 end flag) in the private uplink window.
3.	Repeat 10 times steps 2 and 3.		If timing is evaluated automatically, repeat 999 times.

All observed anomalies, problems and unusual events during execution of the test shall be noted.

6.8.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	OBE transmissions in private uplink windows.	According to Table 6.3	The frame received from the OBE shall in all cases be within the time windows, measured from the last bit of the RSE stop flag.

Table 6.3: Private Up-link Window Timing Limits

Start time	End time
T3 < t < T3 + T4a (160 µs < t < 496 µs)	t < T3 + (N3+overhead)/U8 (t < 5496 µs)

6.8.3 TC08-C: OBE Uplink to Downlink Turn Around Time

The purpose of this test is to verify that, after transmission, the OBE is able to receive the first arriving frame afterwards (i.e. OBE Tx to Rx mode switching mode). This is the time from the last transmitted bit in the uplink frame, until the OBE is able to receive the preamble of an incoming downlink frame. This test assumes that premature termination of uplink frames is allowed.

6.8.3.1 Equipment and Set-up

The test set-up shall be similar to what is described in 5.1, enhanced in order to measure time intervals in the range from 0 µs to 100 µs.

OBEs according to 4.1 shall be used.

The equipment shall be placed in such a way that optimal communication can be foreseen.

6.8.3.2 Main Execution Steps

The RSE shall be set up to respond to a private uplink window request by, in the immediately following frame, allocating a private uplink window for the OBE. The preamble of the immediately following frame shall start T1 after receiving the last bit of

the stop flag of the OBE transmitted frame. The steps according to the tables below shall be executed.

STEP	ACTION	EXPECTED RESPONSE	NOTE
1.	Configure the BST according to 5.1.2.. Send BST every (5-10) ms until an uplink frame is received.	PrWRq according to C.1.2 in [MOPTT_ST1].	A detector shall measure the time from the last bit of the RSE stop flag till the first bit of received OBE start flag, and from there to the last bit of the received OBE stop flag. The preamble of the immediately following frame shall start T1 (= 32 µs) after receiving the last bit of the stop flag of the OBE transmitted frame
2.	Send PrWA according to C.1.3 in [MOPTT_ST1].	VST according to C.1.4 in [MOPTT_ST1].	The RSE shall start transmitting the PrWA start T1 (= 32 µs) after receiving the last bit associated with the PrWRq frame. Note whether the OBE responds with its VST in the allocated private up-link window. The RSE shall not reallocate the private uplink window. For this test, the arrival of a VST shall be termed successful, while no VST shall be termed a failure.
3.	Repeat 10 times steps 1 and 2.		If timing is evaluated automatically, repeat 99 times.

All observed anomalies, problems and unusual events during execution of the test shall be noted.

In case of failure, then the start time of the transmission of the PrWA shall be modified to T1+C, where C is increased (e.g. in steps of 5 µs) until the VST is properly received. The value of C shall be part of the Test result documentation.

6.8.3.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	OBE uplink to downlink turn around time – Reception of VST	The VST shall always be successfully received for C ≤ 5 µs	The preamble of the immediately following frame shall start T1+C after receiving the last bit of the stop flag of the OBE transmitted frame.

6.9 TC09: DSRC Radio Frequency Properties

The radio frequency properties of the OBE shall be measured as established in [ETSI], using the specific sections of [ETSI] defined in 6.9.1, 6.9.2 and 6.9.3, but restricted to two temperatures: 0º C and 55º C. However, alternative but equivalent test set-ups and test procedures are acceptable, subject to prior MOPTT approval.

6.9.1 TC09-A: OBE Sensitivity

The purpose of this test is to verify that the minimum level power density expressed in dBm (received isotropically) produces a wanted response from the OBE – i.e. the OBE sensitivity.

6.9.1.1 Equipment and Set-up

The test set-up shall be according to 9.1.2 in [ETSI].

OBEs according to 4.1 shall be used.

6.9.1.2 Main Execution Steps

The method of measurement and execution of this test shall be according to 9.1.2 in [ETSI].

6.9.1.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	OBE sensitivity (D11b)	-43 dBm	The sensitivity of the OBE during normal and extreme test conditions shall be better than the limit.

6.9.2 TC09-B: OBE Conversion Gain

The purpose of this test is to verify the OBE conversion gain – the difference between the OBE received and the re-radiated subcarrier power – meets the interoperable radio frequency requirements.

6.9.2.1 Equipment and Set-up

The test set-up shall be according to 9.3.2 in [ETSI].

OBEs according to 4.1 shall be used.

6.9.2.2 Main Execution Steps

The method of measurement and execution of this test shall be according to 9.3.2 in [ETSI].

6.9.2.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	OBE conversion gain (U12)	Minimum 1 dB Maximum 9 dB	The defined limits apply for each sideband.

6.9.3 TC09-C: OBE Spurious Emissions

The purpose of this test is to verify that the OBE spurious emissions at frequencies, other than those of the OBE subcarriers and sidebands associated with normal modulation, radiated by the OBE do not exceed the permitted power levels.

6.9.3.1 Equipment and Set-up

The test set-up shall be according to 9.6.2 in [ETSI].

OBEs according to 4.1 shall be used.

6.9.3.2 Main Execution Steps

The method of measurement and execution of this test shall be according to 9.6.2 in [ETSI], modified as follows [8]:

In Band Measurement Spot Frequencies	
Channel 1-0: 5796 and 5799 MHz	**Channel 1-1:** 5795.5 and 5799.5 MHz
Channel 2-0: 5801 and 5804 MHz	**Channel 2-1:** 5800.5 and 5804.5 MHz
Channel 3-0: 5806 and 5809 MHz	**Channel 3-1:** 5805.5 and 5809.5 MHz
Channel 4-0: 5811 and 5814 MHz	**Channel 4-1:** 5810.5 and 5814.5 MHz

First, the RSE is configured with a BST according to 5.1.2 and transmit frequency = 5807.5 MHz. Spurious emission levels shall be recorded at the in band measurement spot frequencies indicated, except those of channel 3-0. Then, the RSE is configured with a BST according to 5.1.2 except that profile = Profile 1 and transmit frequency = 5802.5 MHz. Spurious emission levels shall be recorded at the in band measurement spot frequencies indicated, except those of channel 2-1. OBE incident power shall not exceed –24 dBm.

Measurement bandwidth	Out of band: 1 MHz; In band: 500 KHz.
In band:	Measurement band from 5790 MHz to 5820 MHz, equal to the RTTT frequency band from 5795 MHz to 5815 MHz plus a 5 MHz guard band on each side.
Out of band:	Frequencies below 5790 MHz and above 5820 MHz

6.9.3.3 Acceptance Criteria

ITEM	ACCEPTANCE CRITERIA	LIMIT	NOTE
1.	OBE spurious emissions – OBE in operating state	a) Out of Band Power : ≤-30 dBm in 1 MHz b) Spurious emission in any other uplink channel @ in band measurement spot frequencies: max. ≤-39 dBm in 500 KHz	The defined limits apply for normal test conditions.
2.	OBE spurious emissions – OBE in stand-by state	a) Out of Band Power : ≤-47 dBm in 1 MHz b) Spurious emission in any other uplink channel @ in band measurement spot frequencies: max. ≤-44 dBm in 500 KHz	The defined limits apply for normal test conditions.

[8] At the present there is a mismatch between [ETSI] and the latest CEN Layer 1 specification. Until [ETSI] is updated, use of the test procedure specified here is indicated.

Annex A – Conformity Statement to MOPTT Specification

The following text is an example of the conformity statement. The supplier may elect to use different wording, but it has to convey the same meaning. For instance, instead of the detailed list of standards, an indirect reference to them can be made via the transaction specification [MOPTT_ST1].

Conformity Statement

We, (Supplier Name), hereby declare that we are fully in support of all the specifications contained in the current version of the document:

"Electronic Fee Collection and Other Applications

Specification for Interoperability in the Beacon - Transponder Transaction",

issued by the Public Works, Transport and Telecommunications Ministry (MOPTT) of Chile. To this end, transponders for the Chilean market will support the transactions described in the said document. Also, they will be compliant with the following standards and specifications, as well as to other standards referenced in them:

Draft prEN 12253: 2001	Road Traffic and Transport Telematics (RTTT) Dedicated Short Range Communication (DSRC) DSRC Physical Layer using Microwave 5.8 GHz
Draft EN 12795: 2000	Road Traffic and Transport Telematics (RTTT) Dedicated Short Range Communication (DSRC) DSRC Data Link Layer: Medium Access and Logical Link Control
Draft EN 12834: 2000	Road Traffic and Transport Telematics (RTTT) Dedicated Short Range Communication (DSRC) Application Layer
Draft prEN 13372: 2002	Road Traffic and Transport Telematics (RTTT) Dedicated Short Range Communication (DSRC) DSRC Profiles for RTTT Applications
Draft prEN ISO 14906: 2002	Road Traffic and Transport Telematics (RTTT) Electronic Fee Collection (EFC) Application Interface Definition for Dedicated Short Range Communications

ENV ISO 14816: 1997	Road Traffic and Transport Telematics (RTTT) AVI/AEI: Numbering and Data Structures
ISO 3166-1: 1987 (E)	Codes for the Representation of Names of Countries and their Subdivisions. Part 1: Country Codes
ISO 8731-1: 1987 (E)	Banking Approved Algorithms for Message Authentication
GSS: Feb. 1999	Global Specification for Short Range Communication Bosch Telecom GmbH, Alcatel CGA Transport, Combitech Traffic Systems AB
TR 4001 A1: June 12, 1999	Version ER9_1.3 Interoperable EFC Transaction Using Central Account Based on DSRC Alcatel, Combitech, Kapsch, CSSI

Annex B – Security Functions

B.1 Element Access

B.1.1 Calculation of Element Access Key

The element access key EAcK is derived from a 16-octet long master element access key MEAcK. The derivation is based on the triple-DES (TDES) algorithm using the OBEGroupID value. The EAcK is calculated and stored in the OBE together with the OBEGroupID in the OBE personalisation process.

The EAcK has the length of 8 octets and is derived from the MEAcK using the OBEGroupID:

EAcK = TDES (MEAcK, OBEGroupID || OBEGroupID || OBEGroupID || OBEGroupID)

The following hex values are used in the calculation of the element access keys in this document.

OBEGroupID	= 0F D3
$MEAcK_{\text{Interoperable EFC Element}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
$MEAcK_{\text{Transponder Issuer Element}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
$MEAcK_{\text{Parking Element}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
$MEAcK_{\text{Traffic Probe Element}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0

B.1.2 Calculation of Access Credentials

The derivation of the access credentials AC_CR is based on the DES algorithm. AC_CR is four octets long and is obtained with key EAcK using the random number RndOBE supplied by the OBE:

$$AC\_CR = \text{four left octets of } [DES (EAcK, RndOBE \,||\, 00\ 00\ 00\ 00_{16})]$$

B.2 Attribute Authentication

B.2.1 Calculation of Element Authentication Keys

The element authentication keys EAuK have the length of eight octets and are derived from the 16 octet long master authentication keys MEAuK as described below:

$$EAuK = TDES (MEAuK, ContractSerialNumber \| ContractProvider \| 00_{16})$$

The EAcK keys are calculated and stored in the OBE together with ContractSerialNumber and ContractProvider values during the OBE personalisation process.

The following hex values are used in the calculation of the element authentication keys in this document.

ContractProvider	= 72 40 01
ContractSerialNumber $_{\text{Interoperable EFC}}$	= AE 17 1E D3
MEAuKA1 $_{\text{Interoperable EFC}}$	= 3D D5 A2 AC 5D 10 21 18 71 A3 75 6C 71 96 BD F0
MEAuKA2 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
MEAuKF1 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
MEAuKF2 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
MEAuKI1 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
MEAuKI2 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
MEAuKI3 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
MEAuKI4 $_{\text{Interoperable EFC}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0
ContractSerialNumber $_{\text{Parking Managem.}}$	= 1A 83 89 C5
MEAuK $_{\text{Parking Management}}$	= 9E 3D 7E D1 41 A9 79 5B 7B EA 75 6C 71 96 BD F0

B.2.2 Calculation of OBE, Fiscal and Contract Authenticators

The derivation of the OBE, fiscal and contract authenticators is based on the CBC-DES algorithm. Authenticators are four octets long and are obtained with the selected EAuK key using the attribute EquipmentStatus and the random number RndRSE supplied by the RSE:

$$Authenticator = \text{four left octets of } [CBC\text{-}DES (EAuK, EquipmentStatus \| RndRSE \| 00\ 00\ 00\ 00\ 00\ 00_{16})]$$

B.3 Receipt Authentication

B.3.1 Calculation of Derived Receipt Authentication Key

ReceiptAuthenticator is calculated with CBC-DES and an eight-octet long derived receipt authenticator key DeReAuK.

The DeReAuK is used in the calculation to protect the 16-octet long master receipt authenticator key MReAuK. The derivation is made using the Triple-DES (TDES) algorithm with the attribute ContractSerialNumber and the field ContractProvider of the EFC-ContextMark:

$$DeReAuK = TDES (MREAuK, ContractSerialNumber \| ContractProvider \| 00_{16})$$

The following key is used in the calculation of ReceiptAuthenticator in this document:

MreAuKey = A0 37 51 D6 79 E7 CD FC 86 B2 B7 FD 5D 15 17 7E

B.3.2 Calculation of the Receipt Authenticator

The derivation of the receipt authenticator is based on the CBC-DES algorithm. The receipt authenticator is four octets long and is obtained with the DeReAuK key over the attributes ReceiptServicePart and SessionClass:

$$ReceiptAuthenticator = \text{four left octets of } [CBC\text{-}DES (DeReAuK, ReceiptServicePart \| SessionClass \| 00\ 00\ 00\ 00_{16})]$$