TECHNICAL SPECIFICATION

ISO/TS 16401-2

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Electronic fee collection — Evaluation of equipment for conformity to ISO/TS 17575-2 —

Part 2: Abstract test suite

Perception du télépéage — Évaluation de conformité de l'équipement à l'ISO/TS 17575-2 —

Partie 2: Suite d'essai abstraite

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Contents

Page

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 16401-2 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*, in collaboration with Technical Committee CEN/TC 278, *Road transport and traffic telematics*.

ISO/TS 16401 consists of the following parts, under the general title *Electronic fee collection — Evaluation of equipment for conformity to ISO/TS 17575-2*:

— *Part 1: Test suite structure and test purposes*

— *Part 2: Abstract test suite*

Introduction

This part of ISO/TS 16401 is part of a set of standards that supports interoperability of autonomous EFC-systems, which includes ISO/TS 17575 parts 1 to 4 that define the EFC context data, their charge reports and their use of communication infrastructure.

Within the suite of EFC standards this conformance evaluation procedure defines the process and tests for conformity evaluation of Front End and Back End that comply with the requirements in ISO/TS 17575-2.

This part of ISO/TS 16401 is intended to

— assess Front End Communications API and Front End Application capabilities,

— assess Front End Communications API and Front End Application behaviour,

— serve as a guide for Front End Communications API and Front End Application conformance evaluation and type approval,

— achieve comparability between the results of the corresponding tests applied in different places at different times, and

— facilitate communications between parties.

This part of ISO/TS 16401 is based on

— ISO/TS 17575-2, and

— the ISO/IEC 9646 family of standards on conformance test methodology.

Electronic fee collection — Evaluation of equipment for conformity to ISO/TS 17575-2 —

Part 2:
Abstract test suite

1 Scope

This part of ISO/TS 16401 specifies the Abstract Test Suite (ATS) to evaluate the conformity of Front End Communications API and Front End Application to ISO/TS 17575-2.

The objective of the present document is to provide a basis for conformance tests for Front End Communications API and Front End Application in Electronic Fee Collection based on autonomous on-board equipment (OBE) to enable interoperability between different equipment supplied by different manufacturers.

The present abstract test suite is directly derived from ISO/TS 17575-2.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 17575-1, *Electronic fee collection — Application interface definition for autonomous systems — Part 1: Charging*

ISO/TS 17575-2, *Electronic fee collection — Application interface definition for autonomous systems — Part 2: Communication and connection to the lower layers*

ISO/TS 17575-3, *Electronic fee collection — Application interface definition for autonomous systems — Part 3: Context data*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 17575-1 and the following apply.

3.1
conformance testing
testing the extent to which an IUT is a conforming implementation

[ISO/IEC 9646-1, definition 3.3.23]

3.2
contract
expression of an agreement between two or more parties concerning the use of the road infrastructure

[ISO 14906:2011, definition 3.7]

NOTE A *contract* specifies obligations, permissions and prohibitions for the objects involved.

3.3
Front End application
part of the Front End above the API

[ISO/TS 16401-1:2011, definition 3.2]

3.4
implementation under test
IUT
implementation of one or more OS1 protocols in an adjacent user/provider relationship, being that part of a real open system which is to be studied by testing

[ISO/IEC 9646-1, definition 3.3.43]

3.5
service provider
operator that accepts the user's payment means and in return provides a *road*-use service to the user

NOTE Taken from ISO 14906:2004.

3.6
system under test
SUT
real open system in which the IUT resides

[ISO/IEC 9646-1, definition 3.3.103]

3.7
test case
an abstract or executable test case

[ISO/IEC 9646-1, definition 3.3.107]

3.8
toll charger
legal entity charging toll for vehicles in a *toll domain*

[ISO/TS 17574:2009, definition 3.27]

4 Abbreviations

For the purposes of this document, the abbreviations given in ISO/TS 16401-1 and the following apply.

EUT Equipment Under Test

IUT Implementation Under Test

PIXIT Protocol Implementation Extra Information for Testing

SCS Semiconductor Characterization System

SUT System Under Test

TC Test Case

5 Abstract Test Method (ATM)

This clause describes the ATM used to test the layers at the FE side and at the BE side.

5.1 Implementations Under Tests

5.1.1 Front-End (FE)

The part(s) of the toll system where usage data for an individual user are collected, processed and delivered to the Back End. The Front End comprises the on-board equipment and optionally a proxy.

5.1.2 Back-End (BE)

Generic name for the computing and communication facilities of the Service Provider and/or the Toll Charger.

5.2 Test architecture

The implementation under test is either the FE or the BE. The System under test comprises also the communication sub-layer, which is necessary to perform the IUT tests.

The tester executes the TTCN-3 test cases of the present Test Specification, running on an emulated communication sub-layer.

The figure below describes the test architecture.

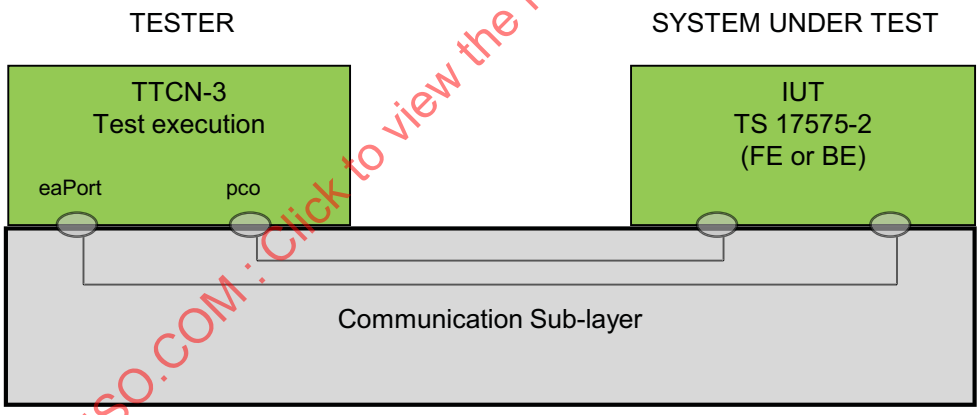

Figure 1 — Test system architecture

5.3 Protocol Implementation Extra Information for Testing (PIXIT)

The supplier of the Front End and Back End, respectively, is responsible for providing a Protocol Implementation Extra Information for Testing (PIXIT).

The supplier of the Front End and the Back End shall complete a PIXIT; see Annex B for the proforma.

6 Untestable Test Purposes (TP)

This clause gives a list of TPs which are not implemented in the Abstract Test Suite due to the chosen Abstract Test Method or other restrictions.

Table 1 — Untestable TPs

Test purpose	Reason
(empty)	(empty)

NOTE Currently no untestable TPs have been identified.

7 ATS data structures

7.1 Implementation of proposed in 'annex D.2. API Definition in C'

The ATS is based on an API definition as depicted in ISO/TS 17575-2, D.2:

— A function call is implemented as a sent message. The template message used match the C function signature and the C data structures defined in D.2

— The return function call is implemented as a received message The template message used match the C function signature

— The call-backs are implemented by as received message The template message used match the C call-back signature

7.2 Common data types

They are reduced to an enumerate structure of communication functions error code as depicted in ISO/TS 17575-2, Annex D.

8 External functions

No external functions are used.

9 Message filtering

As depicted in ISO/TS 17575-2, D.2, each call-back event is ignored by default.

Thus, each a receive cal back event statement was added in the default behaviour, to ignore it on the "pco" port, which have a valid ADU structure and were not handled in the test case behaviour.

The corresponding TTCN-3 code is as following:

```
[] pco.receive(mw_instanceStateChange_any) {
     repeat; // Ignore state transition
}
```

10 ATS naming conventions

The ATS naming conventions are intended to provide an easier reading of the ATS by using rules for naming objects.

10.1 Definition naming conventions

To define the ATS naming conventions, the following principle are taken into consideration:

— Prefixes are short alphabetic string indicating the type of TTCN-3 element it represents (see table 2 below).

— Suffixes should not be used except in those specific cases identified in Table 2 below.

— Prefixes and suffixes should be separated from the body of the identifier with an underscore ("_"):

```
EXAMPLE 1      c_sixteen, t_wait_max.
```

— Only module names, data type names and module parameters should begin with an upper-case letter. All other names (i.e. the part of the identifier following the prefix) should begin with a lower-case letter.

— The start of second and subsequent words in an identifier should be indicated by capitalizing the first character. Underscores should not be used for this purpose.

```
EXAMPLE 2      f_compareDateAndTime.
```

The Table 2 below specifies the naming guidelines for each element of the TTCN-3 language indicating the recommended prefix, suffixes (if any) and capitalization.

Table 2 — TTCN-3 naming convention

Language element	Naming convention	Prefix	Suffix	Example	Notes
Module	Use upper-case initial letter	*none*	*none*	ContextData_TE	
TSS grouping	Use all upper-case letters	*none*	*none*	TP_RT_PS_TR	
Item group within a module	Use upper-case initial letter	*none*	*none*	`Valid_Behaviour`	
Data type	Use upper-case initial letter	*none*	*none*	ChargeReport	
List type identifiers	Use upper-case initial letter	none	*none*	`TimeClassesGroups`	
Message template	Use lower-case initial letter	m_	none	`m_Iso17575_3Adu`	
Message template with wildcard or matching expression	Use lower-case initial letters	mw_	none	`mw_Iso17575_3Adu_default`	
Port instance	Use lower-case initial letter	*none*	*none*	pco	
External function	Use lower-case initial letter	fx_	*none*	`fx_getCurrentTime`()	
Constant	Use lower-case initial letter	c_	*none*	`c_attr_11`	
Function	Use lower-case initial letter	f_	*none*	f_authentication()	
Altstep	Use lower-case initial letter	a_	*none*	a_receiveContextData()	
Altstep (Default)	Use lower-case initial letter	d_	*none*	`d_ADU_filter` ()	
Variable	Use lower-case initial letter	v_	*none*	v_idx	
Timer	Use lower-case initial letter	t_	_min _max	t_wait	Note 1
Module parameters PICS values PIXIT values	Use all upper case letters	*none*	*none*	 PIC_time PX_ORGINATOR_RECIPIENT	Note 2
Parameterization	Use lower-case initial letter	p_	*none*	p_beginOfPeriod	
Enumerated Value	Use lower-case initial letter	e_	*none*	`e_ERNoError`	

NOTE 1: If a time window is needed, the suffixes "_min" and "_max" should be appended.
NOTE 2: In this case it is acceptable to use underscore as a word delimiter.

10.2 Test Case identifier

The test case naming conventions follow the TP naming conventions.

TC_<group>_<dut>_<x>_<nn>

TC : to indicate that it is a Test Case;

<group> : which group TP belongs to;

applicable for FE Communications API	IH	Instance Handling
applicable for FE Communications API	SH	Session Handling
applicable for FE Application	SH	Session Handling
applicable for FE Communications API	CSP	Communications Service Primitives
applicable for FE Communications API	ST	State Transitions

<dut> : type of DUT (i.e. FE Communications API - API or FE Application - APPL);

X : type of testing (i.e. Valid Behaviour tests – BV, or Invalid Behaviour tests – BI)

<nn> : sequential TP number (01-99)

EXAMPLE TC_CSP_API_BV_04

10.3 TTCN-3 modules identifier

The following naming conventions are applied for module naming, where <set> is the name of the set of modules:

— <set>_TypesAndValues: this module provides all types (record, set…) and values (constants, enumerated…)

— <set>_Functions: this module provides all TTCN-3 functions used for validations, comparisons…

— <set>_Templates: this module provides all templates, for sent and received messages

— <set>_Pixits: this module provides the PIXITs for automatic configurations

— <set>_PICS: this module provides PICS definitions

— <set>_TCs: this module provides all the test cases of the project

— <set>_TE: this module provides the control part

EXAMPLE Communication_Templates.ttcn or Communication_TE.ttcn

For the purposes of this part of ISO/TS 16401, two sets of module apply: the common modules and the ContextData modules.

For convenience, the TTCN-3 file names are identical as module name they contain.

Annex A
(informative)

TTCN-3 Library modules for FE and BE

A.1 Electronic annex, zip file with TTCN-3

The TTCN-3 source code and the ASN.1 definitions, which form parts of the present standard, are contained in the archive Communication_ttcn3_asn1.zip, which contains:

— The Communication TTCN-3 files,

— The common TTCN-3 files.

A.2 Electronic annex, zip file with HTML documentation

The HTML documentation, which forms parts of the present standard, is contained in the archive Communication_html_doc.zip. Start the index.htm file in any preferred web browser.

Annex B
(informative)

PIXIT Proforma for FE and BE

B.1 Introduction

The protocol implementation extra information for testing (PIXIT) proforma is based on ISO/IEC 9646-6, which can be consulted for any additional necessary information.

B.2 Identification summary

Table B.1 — Identification summary

PIXIT Number:	
Test Laboratory Name:	
Date of Issue:	
Issued to:	

B.3 ATS summary

Table B.2 — ATS summary

Protocol Specification:	
Protocol to be tested:	
ATS Specification:	
Abstract Test Method:	

B.4 Test laboratory

Table B.3 — Test laboratory

Test Laboratory Identification:	
Test Laboratory Manager:	
Means of Testing:	