TECHNICAL REPORT

ISO/TR 16401-2

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2018-01

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

Part 2: Abstract test suite

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

Partie 2: Suite d'essai abstraite

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This first edition of ISO/TR 16401-2 cancels and replaces ISO/TS 16401-2:2012, which has been technically revised.

The main changes compared to the previous edition are as follows:

— conversion from a Technical Specification to Technical Report has been made;

— the terms and definitions have been revised;

— editorial and formal corrections as well as changes to improve readability have been made.

A list of all parts in the ISO 16401 series can be found on the ISO website.

Introduction

This document is part of a set of standards that supports interoperability of autonomous electronic fee collection (EFC) systems. Autonomous systems use satellite positioning, often combined with additional sensor technologies such as gyroscopes, odometers, and accelerometers, to localize the vehicle and to find its position on a map containing the charged geographic objects, such as charged roads or charged areas. From the charged objects, the vehicle characteristics, the time of day and other data that are relevant for describing road use, the tariff and ultimately the road usage fee are determined.

The ISO/TR 16401 series provides tests to assess the Front End Communications API and Front End application behaviours compliancy towards the requirements listed in ISO 17575-2. ISO/TR 16401-1 contains the definition of such tests in the form of test purposes, listing the initial conditions, references and individual steps in a structured textual manner. This document contains the identical tests written in Testing and Test Control Notation version 3 (TTCN-3).

Autonomous on-board equipment (OBE) operates without relying on dedicated road-side infrastructure by employing wide-area technologies such as Global Navigation Satellite Systems (GNSS) and Cellular Communications Networks (CN). Therefore, autonomous systems may also be referred to as GNSS/CN systems.

Within the suite of EFC standards, this document defines tests for conformity evaluation of Front End and Back End that comply with the requirements towards the context data specified in ISO 17575-2.

This document 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.

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

Part 2:
Abstract test suite

1 Scope

This document contains the definition of test cases, reflecting the individual steps listed in specific test purposes defined in ISO/TR 16401-1. The test cases are written in Testing and Test Control Notation version 3 (TTCN-3).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 17575-1, *Electronic fee collection — Application interface definition for autonomous systems — Part 1: Charging*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

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

[SOURCE: ISO/IEC 9646-1:1994, 3.3.23]

3.2
Front End application
part of the Front End above the API

[SOURCE: ISO/TR 16401-1:2017, 3.12]

3.3
implementation under test
IUT
implementation of one or more OSI protocols in an adjacent user/provider relationship, being that part of a real open system which is to be studied by testing

[SOURCE: ISO/IEC 9646-1:1994, 3.3.43]

3.4
system under test
SUT
real open system in which the IUT resides

[SOURCE: ISO/IEC 9646-1:1994, 3.3.103]

3.5
test case
abstract or executable test case

[SOURCE: ISO/IEC 9646-1:1994, 3.3.107]

3.6
toll service provider
entity providing toll services in one or more toll domains

[SOURCE: ISO 17573:2010, 3.23, modified — the definition has been revised.]

4 Abbreviated terms

ADU	application data unit
API	application programming interface
ASN.1	Abstract Syntax Notation One
ATM	abstract test method
ATS	abstract test suite
BE	Back End
BI	behaviour invalid
BV	behaviour valid
CN	cellular network
DUT	device under test
EFC	electronic fee collection
FE	Front End
GNSS	Global Navigation Satellite Systems
ID	identifier
IUT	implementation under test
OBE	on-board equipment
PICS	Protocol Implementation Conformance Statements
PIXIT	Protocol Implementation Extra Information for Testing
SCS	semiconductor characterization system
SUT	system under test

TC test case

TP test purposes

TSS test suite structure

TTCN Testing and Test Control Notation

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)

FE refers to 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)

BE is the 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 this document, running on an emulated communication sub-layer.

Figure 1 describes the test architecture.

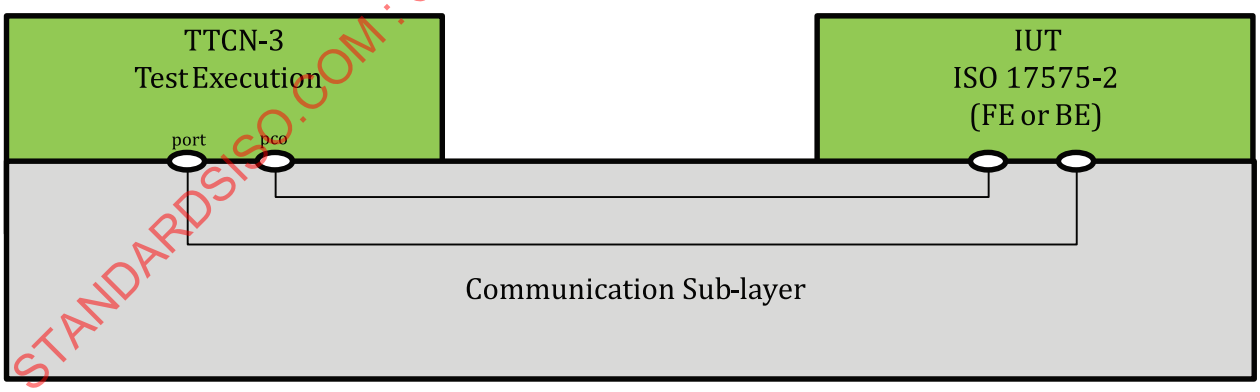

Figure 1 — Test system architecture

5.3 Protocol Implementation Extra Information for Testing (PIXIT)

The supplier of the Front End and Back End, respectively, should provide a Protocol Implementation Extra Information for Testing (PIXIT); see Annex B for the proforma.

6 Untestable test purposes (TP)

Table 1 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 General

The data structures are defined in the base standards using ASN.1. The ATS is using the data definition of ASN.1 except for the data structures using advanced parametrization, where all the data structures are manually re-defined using the TTCN-3[8].

7.2 Common data types

Common data types are reduced to an enumerate structure of error codes for communication functions as described in ISO 17575-2:2016, Annex D.

8 External functions

No external functions are used.

9 Message filtering

As depicted in ISO 17575-2:2016, D.2, each call-back event is ignored by default.

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

The corresponding TTCN-3 code is as follows:

```
[] 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 principles are taken into consideration.

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

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

— 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.`

Table 2 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>_<iut>_<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;
<iut>	: type of IUT [i.e. FE Communications API (API) or FE Application (APPL)];		
X	: type of testing [i.e. behaviour valid tests (BV) or behaviour invalid 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 document, two sets of module apply: the common modules and the ContextData modules.

For convenience, the TTCN-3 file names are identical with the 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.MP representation corresponding to this ATS is contained in ASCII files (TTCN and ASN.1 source code files are located in the folder Charging) in the archive CEN 16401-2(2018).zip, which accompanies this document. The HTML documentation, which forms parts of this document, is contained in HTML files (located in the folder HTML) located in the archive listed above. Start the index.htm file in any preferred web browser. The SHA-256 cryptographic digest of the archive is 66FDD6948516CCDC0C50DA35F3A7A5B4A22E12F08DBE538F0A91D16F9BE15519, which can be used to verify its integrity. The SHA-256 algorithm is specified in NIST 180-4.

NOTE 1 The above referenced file [i.e. CEN 16401-2(2018).zip] is freely available for download via hyperlink at www.itsstandards.eu/index.php/efc#EFCstandards.

NOTE 2 Be aware that pasting the text of the file into one of the hash digest computation pages available on the web may result in a non-matching hash digest due to changes in the underlying coding.

Annex B
(informative)

PIXIT proforma for Front End Communications API and Front End application

B.1 General

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:	

B.5 Client identification

Table B.4 — Client identification

Client identification:	
Client test manager:	
Test facilities required:	