INTERNATIONAL STANDARD

ISO 16410-2

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Electronic fee collection — Evaluation of equipment for conformity to ISO 17575-3 —

Part 2:
Abstract test suite

Perception du télépéage — Évaluation de la conformité de l'équipement à l'ISO 17575-3 —

Partie 2: Suite d'essais abstraite

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Foreword

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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).

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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 16410-2 cancels and replaces ISO/TS 16410-2:2012, which has been technically revised. The following changes have been made:

— conversion from a Technical Specification to an International Standard;

— amendments to reflect changes to the underlying base standards, especially ISO 17575;

— major changes regarding:

  — data element changes introduced by ISO 17575-1:2016 and ISO 17575-3:2016;

— new test cases related to:

  — protocol version handling;

  — toll context partitions;

  — fee calculation algorithm;

  — rounding rules;

  — alternative currency;

— removed test cases related to:

  — communicatons services;

  — rules with respect to support of context data which are not anymore required by ISO 17575-3:2016;

— revised terms and definitions;

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is part of a series standards that supports interoperability of autonomous EFC-systems. Autonomous systems use satellite positioning, often combined with additional sensor technologies such as gyroscopes, odometers, and accelerometers, to localise 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 is determined.

Autonomous on-board equiment (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 ISO 16410 series 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 17575-3.

ISO 16410-2 is based on ISO 16410-1.

Electronic fee collection — Evaluation of equipment for conformity to ISO 17575-3 —

Part 2:
Abstract test suite

1 Scope

The ISO 16410 series provides a suite of tests in order to assess the Front End (FE) and Back End (BE) behaviour's compliancy towards the requirements listed in ISO 17575-3. This document contains the definition of such tests in the form of test cases, reflecting the required individual steps listed in specific test purposes defined in ISO 16410-1. The test cases are written in Testing and Test Control Notation version 3 (TTCN v3).

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 16410-1, *Electronic fee collection — Evaluation of equipment for conformity to ISO 17575-3 — Part 1: Test suite structure and test purposes*

ISO 17575-1:2016, *Electronic fee collection — Application interface definition for autonomous systems — Part 1: Charging*

ISO 17575-3:2016, *Electronic fee collection — Application interface definition for autonomous systems — Part 3: Context data*

3 Terms and definitions

For the purposes of this document the following terms and definitions apply.

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

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

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

3.1
Back End
part of a back office system interfacing to one or more Front Ends

[SOURCE: ISO 17575-1:2016, 3.4]

3.2
conformance testing
assessment to determine whether an implementation complies with the requirements

3.3
Front End
part of a tolling system consisting of an OBE, and possibly a proxy where tolling information and usage data are collected and processed for delivery to the Back End

[SOURCE: ISO/TS 19299:2015, 3.17, modified — "road" was deleted and "Back End" is capitalized.]

3.4
implementation under test
implementation of one or more open systems interconnection (OSI) protocols in an adjacent user/ provider relationship, being part of a real system which is to be studied by testing

3.5
system under test
real system in which the implementation under test resides

Note 1 to entry: Adapted from ISO/IEC 9646-1:1994, definition 3.3.103.

3.6
test case
description of test purpose, unique test case identifier, test inputs, test execution conditions, test steps, and the results required to pass the test

[SOURCE: ISO/IEC 18013-4:2011, 4.1]

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

ASN.1	Abstract Syntax Notation One
ATM	Abstract Test Method
ATS	Abstract Test Suite
BE	Back End
DUT	Device Under Test
FE	Front End
IUT	Implementation Under Test
PIXIT	Protocol Implementation Extra Information for Testing
SCS	Semiconductor Characterization System
SUT	System Under Test
TC	Test Case
TTCN-3	Testing and Test Control Notation version 3

# 5 Abstract test method (ATM)

5.1 Introduction

This clause describes the abstract test method (ATM) used to test the layers at the Front End (FE) side and at the Back End (BE) side.

5.2 Test architecture

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

The tester shall execute the testing and test control notation version 3 (TTCN-3) *test cases* of the present document as specified in Annex A, running on an emulated communication sub-layer.

Figure 1 describes the test architecture.
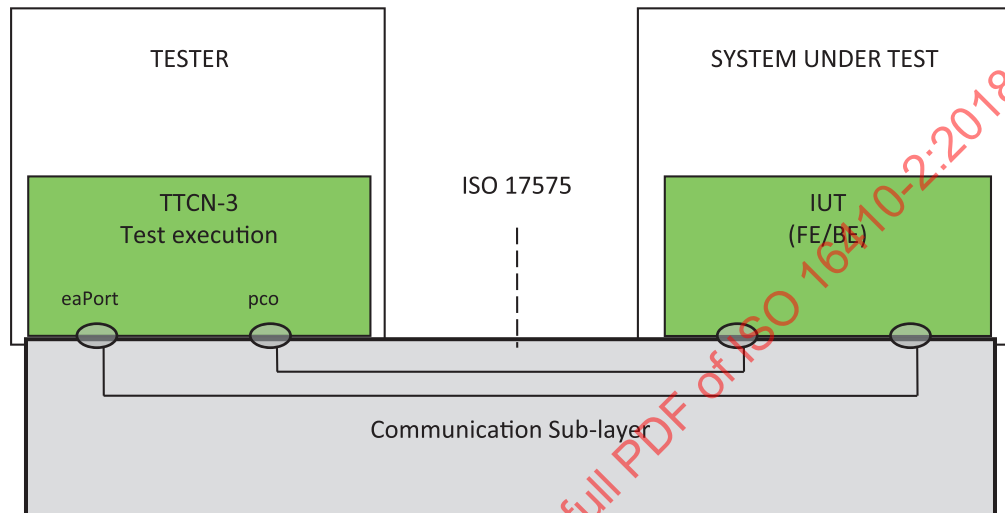
Figure 1 — Test system architecture

5.2.1 Security

Test Purposes defined in ISO 16410-1 cover the following security aspects which are explicitly specified by ISO 17575-3:

— verification that APDUs are embedded into secure packets;

— usage of authenticated usage statement;

— usage of authenticated Charge Report;

— usage of authenticated ISO17575-3Adu.

However, security aspects identified in ISO 17575-3 and ISO 17575-1 which are referenced to their normative references (e.g. ISO/TS 19299:2015, ISO/IEC 8825-2:2015, ISO/IEC 9594-8:2017 and IETF RFC 5035:2007-08) are out of scope of this document and not covered by the Test Purpose definition.

For this reason, the abstract syntax notation one (ASN.1) security modules AuthenticationFramework and ExtendedSecurityServices-2006 have been replaced by abridged (dummy) definitions (AbridgedAuthenticationFrameworkv6.asn and AbridgedExtendedSecurityServices-2006.asn).

To execute the test suite, the Test System shall fully support the security mechanisms as specified in original ASN.1 files.

In order to execute the test cases which include underlying security aspects, appropriate test adapters between SUT and Tester are needed.

5.3 Protocol Implementation Extra Information for Testing (PIXIT)

The supplier of the Front End and Back End, respectively, is responsible for providing the 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 a proforma.

6 Untestable test purposes (TPs)

This clause gives a list of test purposes (TPs) in Table 1, which are not implemented in the abstract test suite (ATS) 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 ASN.1 description

The ATS is based on the following ASN.1 description:

— EfcAutonomousContextData: it provides the ASN.1 description for ContextData support, including ISO 17575-3 ADU descriptions;

— EfcAutonomousCharging: it provides the ASN.1 description for charging support, including AuthenticatedChargeReport and ChargeReportResponse;

— LacModule: it provides the ASN.1 description for Localisation augmentation communication for autonomous systems;

— EfcCcc: it provides the ASN.1 description for Compliance check communication for autonomous systems;

— EfcDsrcGeneric and EfcDsrcApplication: they provide the ASN.1 description for dedicated short-range communication;

— AVIAEINumberingAndDataStructures: it provides the ASN.1 description for Automatic vehicle and equipment identification;

— AuthenticationFramework: it provides the ASN.1 description for security support.

7.2 Parameterized support

Several definitions of data elements, according to the abstract syntax definition one (ASN.1), (see Table 2 for the full list of concerned data elements) use the parametrisation feature of ASN.1. At the time of writing this document, such a feature is not yet supported by TTCN-3 standards. In order to provide a functional and compilable test suite, all the data elements defined in parametrised way in ASN.1 have been manually defined directly in TTCN code, using TTCN-3 advanced parametrisation feature (see EXAMPLE). This measure does not have any implications on the testing procedure, however in order to compile the TTCN-3 code, the software tool to be used for such purpose has to support the TTCN-3 advanced parametrisation feature.

NOTE   Such a workaround is considered temporary.

In case of an update of related requirement standards, the TTCN code should be revised as well in case the update concerns data elements listed in the Table 2 — List of parametrised ASN.1 data elements using advanced parametrisation and their declarations in TTCN-3.

EXAMPLE   Below is an example of re-definition of the data element (using ASNANS.1 parameterisationpara metrisation) in TTCN with advanced parameterisationparametrisation:

```
ASN.1 definition with advanced parameterization (syntactically indicated by {…}):
-- Adoption of T-APDUs for LAC
LAC-T-APDUs ::= CHOICE {
    action-request          [0] Action-Request{LacContainer},
    action-response         [1] Action-Response{LacContainer},
    event-report-request    [2] Event-Report-Request{LacContainer},
    event-report-response   [3] Event-Report-Response,
    set-request             [4] Set-Request{LacContainer},
    set-response            [5] Set-Response,
    reserved4               [6] NULL,        -- get-request
    reserved5               [7] NULL,        -- get-response
    initialisation-request  [8] Initialisation-Request,
    initialisation-response [9] Initialisation-Response
}
TTCN-3 declaration with parameterization (syntactically indicated by <…>):
// -- Adoption of T-APDUs for LAC
type union LAC_T_APDUs <in type Container> {
    Action_Request<Container>          action_request,
    Action_Response<Container>         action_response,
    Event_Report_Request<Container>    event_report_request,
    Event_Report_Response              event_report_response,
    Set_Request<Container>             set_request,
    Set_Response                       set_response,
    Initialisation_Request             initialisation_request,
    Initialisation_Response            initialisation_response
}
```

Table 2 — List of parametrised ASN.1 data elements using advanced parametrisation and their declarations in TTCN-3

ASN.1 data elements	TTCN-3 data elements
Data elements defined in ISO 13141	
EfcLac {iso(1) standard(0) 13141 version2(2)}	
LAC-T-APDUs	type union LAC_T_APDUs <in type Container>
LacContainer	type union LacContainer <in type Container>
Data elements defined in ISO 12813	
efcCcc {iso(1) standard(0) 12813 version2(2)}	
	type union CCC_T_APDUs <in type Container>
	type union CccContainer <in type Container>
Data elements defined in ISO 14906	
EfcDsrcGeneric {iso(1) standard(0) 14906 generic(1) version5(5)}	
Action-Request {Container}	type record Action_Request <in type Container>
Action-Response {Container}	type record Action_Response <in type Container>
Attributes {Container}	type record Attributes <in type Container>
AttributeList {Container}	type set of Attributes<Container> AttributeList<Container>
Event-Report-Request {Container}	type record Event_Report_Request <in type Container>
Get-Response {Container}	type record Get_Response <in type Container>
Set-Request {Container}	type record Set_Request <in type Container>
T-APDUs	type union T_APDUs_Generic <in type Container>
T-APDUs-Generic {EfcContainer}	type T_APDUs_Generic<octetstring> T_APDUs
EfcContainer	type union EfcContainer <in type Container>
ApplicationContextMark	type EfcContainer<octetstring> ApplicationContextMark
ApplicationList	type record ApplicationList_

Table 2 *(continued)*

ASN.1 data elements	TTCN-3 data elements
BST	type record BST
Initialisation-Request	type BST Initialisation_Request
Initialisation-Response	type VST Initialisation_Response
Data elements defined in ISO 14906	
EfcDsrcApplication {iso(1) standard(0) 14906 generic(1) version5(5)}	
GetInstanceRs {Container}	type record GetInstanceRs_ <in type Container>
GetStampedRs {Container}	type record GetStampedRs <in type Container>
SetInstanceRq {Container}	type record SetInstanceRq <in type Container>
SetStampedRq {Container}	type record SetStampedRq <in type Container>
Data elements defined in ISO 17575-1	
EfcAutonomousCharging {iso(1) standard(0) 17575 part1(1) version2(2)}	
ListOfDsrcUsageData	type union ListOfDsrcUsageData <in type Container>
UsageStatement	type record UsageStatement <in type Container>
UsageStatementList	type set of UsageStatement_ <octetstring> UsageStatementList
ChargeReport	type record ChargeReport
Data elements defined in	
EfcAutonomousContextData {iso(1) standard(0) 17575 part3(3) version2(2)}	
Optionally-Signed {Payload}	type union Optionally_Signed <in type Payload>
Signed {Payload}	type record Signed <in type Payload>
Iso17575-3AduBody	type record Iso17575_3AduBody
Iso17575-3Adu	type record Iso17575_3Adu
Iso17575-3InformationContent	type union Iso17575_3InformationContent

8 Message filtering

As indicated in ISO 16410-1:2017, B.2, the ADUs exchanged between the IUT and the tester, which are not part of the test purpose, shall be ignored.

Thus, a receive event statement was added in the default behaviour, to ignore messages received 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 follows:

```
[] pco.receive(mw_Iso17575_3Adu_default) {
    repeat; // Ignore ADU
```

9 ATS naming conventions

9.1 Introduction

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

9.2 Definition naming conventions

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

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

— Suffixes should not be used with the exception of those identified in Table 3.

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

Table 3 — 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_TIMEtime 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.					

9.3 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;

    <dut>   : type of DUT (i.e. FE or BE);

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

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

EXAMPLE   TC_BEF_FE_BV_31.

9.4   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_FE: this module provides PICS definitions for the Front End

— <set>_PICS_BE: this module provides PICS definitions for the Front End

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

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

EXAMPLE   ContextData_Templates.ttcn or ContextData_TE.ttcn.

For the purpose of this document, two sets of module apply: the common modules and the ContextData modules.

The set of common modules contains TTCN-3 definitions, which are used by several test suites (for ISO 17575-1:2016 to ISO 17575-3:2016).

The definitions specific to charging are included in the modules of the charging set.

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

Annex A
(normative)

Abstract test suite (ATS) for FE and BE

A.1 Introduction

This ATS has been produced using the Tree and Tabular Combined Notation (TTCN) according to ISO/IEC 9646-3. The ATS was developed on a separate TTCN software tool and therefore the TTCN tables are not completely referenced in the table of contents. The ATS itself contains a test suite overview part that provides additional information and references.

A.2 TTCN Graphical form (TTCN.GR)

The TTCN.GR representation of this ATS is not present.

A.3 TTCN Machine Processable form (TTCN.MP)

The TTCN.MP representation corresponding to this ATS is contained in an ASCII file (TTCN and ASN.1 source code files are located in the folder Charging) in the archive ISO16410-2(2018).zip, which can be found on the ISO maintenance portal for this document: http://standards.iso.org/iso/16410/-2/ed -1/en. The HTML documentation, which forms parts of the present document, is contained in an HTML file (located in the the folder HTML) located in the archive listed above. Start the index.htm file in any preferred web browser. The SHA-256 cryptographic hash digest of the archive is:

1AB0B6A1B3A664EC47DB489B2B603F29CFDA8CECF5BA5F00033E32D6F4AFB633

which can be used to verify its integrity. The SHA-256 algorithm is specified in NIST 180-4.

NOTE   The above referenced file (i.e. ISO16410-2(2018).zip) is freely available for download via hyperlink at www.itsstandards.eu/index.php/efc#EFCstandards.

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 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 necessary additional information.

B.2 Identification summary

Table B.1 provides identification summary PIXIT proforma.

Table B.1 — Identification summary

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

B.3 ATS summary

Table B.2 provides ATS summary PIXIT proforma.

Table B.2 — ATS summary

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

B.4 Test laboratory

Table B.3 provides test laboratory PIXIT proforma.

Table B.3 — Test laboratory

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

B.5 Client identification

Table B.4 provides client identification PIXIT proforma.