TECHNICAL REPORT

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

Part 1: Test suite structure and test purposes

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

Partie 1: Structure de la suite d'essais et objectifs d'essai

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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 edition of ISO/TR 16401-1 cancels and replaces ISO/TS 16401-1:2012, which has been technically revised.

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

— the document has been converted from a Technical Specification to a Technical Report;

— the terms and definitions have been revised;

— the test purpose naming convention has been changed, i.e. "/" has been replaced by "_";

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

A list of all parts in the ISO/TR 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 is 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. This document 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. ISO/TR 16401-2 contains the identical tests written in Testing and Test Control Notation version 3 (TTCN v3).

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

ISO/TR 16401-1 is based on

— ISO 17575-2, and

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

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

Part 1:
Test suite structure and test purposes

1 Scope

This document covers the test purposes for Front End Communications API covering functionalities related to instance handling, session handling, communication service primitives (i.e. sending/receiving of ADUs) and visible state transitions. It covers EFC communication services described in ISO 17575-2:2016, Clause 5 and PICS proforma in ISO 17575-2:2016, B.2. Claims related to Front End storage capacity are out of scope of this document.

This document covers the test purposes for Front End Application related to session establishment on Back End request and related to session re-establishment when session requested by Back End failed. There are no other claims with respect to Front End Application described in ISO 17575-2.

The underlying communication technology requirements for layer 1 to 4 specified in ISO 17575-2:2016, Clause 6 are out of scope of this document.

Similarly, Back End Communications API is out of scope of this document. According to ISO 17575-2 it is expected that these Front End Communications API will be "reflected" in the BE; however, BE Communications API is out of scope of ISO 17575-2.

Test purposes have been organized into the test suite groups, designated for the Front End Communications API and Front End Application, respectively.

Aside from the test purposes, this document also provides proforma conformance test reports templates for both the Front End and Back End test purposes.

ISO 17575-2 contains more information regarding the requirements against which the conformance is evaluated in this document.

2 Normative references

There are no normative references in this document.

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
area charging
charging based on road usage within a given area

[SOURCE: ISO 17575-1:2016, 3.1]

3.2
attribute
addressable package of data consisting of a single *data element* (3.9)or structured sequences of data elements

[SOURCE: ISO 17575-1:2016, 3.2]

3.3
authenticator
data, possibly encrypted, that is used for authentication

[SOURCE: EN 15509:2014, 3.3]

3.4
Back End
part of a back office system interfacing to one or more *Front Ends* (3.11)

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

3.5
charge object
geographic or road related object for the use of which a charge is applied

[SOURCE: ISO 17575-1:2016, 3.5]

3.6
charge report
information containing road usage and related information originated at the *Front End* (3.11)

[SOURCE: ISO 17575-1:2016, 3.6]

3.7
cordon
border line of an area

[SOURCE: ISO 17575-1:2016, 3.7]

3.8
cordon charging
charging for the crossing of a *cordon* (3.7)

[SOURCE: ISO 17575-1:2016, 3.8]

3.9
data element
coded information, which might itself consist of lower level information structures

[SOURCE: ISO 17575-1:2016, 3.9]

3.10
data set
logical set of *data elements* (3.9) with a semantic relation

[SOURCE: ISO 17575-3:2016, 3.10]

3.11
Front End
part of a tolling system consisting of an *OBE* (3.14) and possibly a *proxy* (3.15) where road tolling information and usage data are collected and processed for delivery to the *Back End* (3.4)

[SOURCE: ISO/TS 19299:2015, 3.17]

3.12
Front End Application
part of the *Front End* (3.11) above the API

[SOURCE: ISO 17575-2:2016, 3.12]

3.13
layout
technical description of the location of tolled objects including their borders

[SOURCE: ISO 17575-3:2016, 3.12]

3.14
on-board equipment
OBE
all required equipment on-board a vehicle for performing required EFC functions and communication services

3.15
proxy
optional part of a *Front End* (3.11) that communicates with external equipment and processes the data received into an agreed format to be delivered to the *Back End* (3.4)

[SOURCE: ISO 17575-1:2016, 3.13]

3.16
road section charging
tolling principle where the fee is due if predefined sections of roads are used

[SOURCE: ISO 17575-1:2016, 3.14]

3.17
toll
charge, tax or duty levied in connection to using a vehicle in a *toll domain* (3.21)

[SOURCE: ISO/TS 19299:2015, 3.42 modified]

3.18
tolled area
geographic area where a *toll* (3.17) is charged for road usage

[SOURCE: ISO 17575-3:2016, 3.17]

3.19
toll context
logical view as defined by *attributes* (3.2) and functions of the basic elements of a toll scheme consisting of a single basic tolling principle, a spatial distribution of the *charge objects* (3.5) and a single behaviour of the related *Front End* (3.11)

[SOURCE: ISO 17575-1:2016, 3.17]

3.20
toll context data
information defined by the responsible Toll Charger necessary to establish the *toll* (3.17) due for using a vehicle on a particular *toll context* (3.19) and to conclude the toll transaction

[SOURCE: ISO 12855:2015, 3.15]

3.21
toll domain
area or part of a road network where a certain *toll regime* (3.22) is applied

[SOURCE: ISO 17573:2010, 3.18]

3.22
toll regime
set of rules, including enforcement rules, governing the collection of *toll* (3.17) in a *toll domain* (3.21)

[SOURCE: ISO 17573:2010, 3.20]

3.23
toll scheme
organizational view of a *toll regime* (3.22), including the actors and their relationships

[SOURCE: ISO 17575-3:2016, 3.22]

3.24
transaction
whole of the exchange of information between two physically separated communication facilities

[SOURCE: ISO 17575-1:2016, 3.21]

3.25
transaction model
functional model describing the structure of electronic payment transactions

[SOURCE: ISO 14906:2011, 3.25 modified]

4 Abbreviated terms

ADU Application data unit

API Application Programming Interface

ASN.1 Abstract Syntax Notation One

ATS Abstract Test Suite

BE Back End

BI Behaviour invalid

BV Behaviour valid

CN Cellular network

IUT Implementation under test

EFC Electronic fee collection

FE Front End

GNSS Global Navigation Satellite Systems

ID Identifier

OBE On-board equipment

PCTR Protocol Conformance Test Report

PICS Protocol Implementation Conformance Statements

TP Test purposes

TSS Test Suite Structure

TTCN Testing and Test Control Notation

5 Test Suite Structure

5.1 Structure

Table 1 shows the Test Suite Structure (TSS).

Table 1 — Test Suite Structures

Group	Type of IUT	Behaviour
Instance handling	Front End Communications API	Behaviour valid
		Behaviour invalid
Session handling	Front End Communications API	Behaviour valid
		Behaviour invalid
	Front End Application	Behaviour valid
Communication service primitives	Front End Communications API	Behaviour valid
		Behaviour invalid
State transitions	Front End Communications API	Behaviour valid

5.2 Reference to conformance test specifications

This document takes into account already defined test purposes for conformance to the base standards by referencing them, so that

a) for test purposes that are **identical** to those defined in this document or the base standards conformance test cases, direct reference is reported; for reader's convenience, the title or a verbal description of the referenced test purpose is given, together with the reference,

b) for test purposes that are **derived** from those defined in the base standards conformance test cases, a direct reference is reported, plus an indication on how the referred test purpose has to be modified for the profile conformance testing,

c) for test purposes that are **specific** to ISO 17575-2, complete description is given, and

d) an indication on whether a test purpose is **identical**, **derived** or **specific** is given in each test purpose.

5.3 Test purposes (TP)

5.3.1 TP definition conventions

The TPs are defined following the rules shown in Table 2. Test purposes are defined in Annex A and Annex B, including the following special notation and symbol conventions.

Table 2 — TP definition rules

TP ID according to the TP naming conventions	**Title:**
	Reference:
	TP origin:
	Initial condition:
	Stimulus and expected behaviour:

TP ID	The TP ID is a unique identifier. It is specified according to the TP naming conventions defined in the subclause below.
Title	Short description of TP objective.
Reference	The reference should contain the references of the subject to be validated by the actual TP (specification reference, clause, paragraph), or the reference to the standard document defining the TP.
TP origin	Indicates if the TP is **identical** to a TP defined in another test standard, **derived** from a TP defined in another test standard, or **specific** for this standard profile.
Initial condition	The condition defines in which initial state the IUT has to be to apply the actual TP.
Stimulus and expected behaviour	Definition of the events the tester performs and the events that are expected from the IUT to conform to the base specification.

5.3.2 TP naming conventions

Each TP is given a unique identification. This unique identification is built up to contain the following string of information:

TP_<group>_<iut>_<x>_<nn>

TP : indicates that it is a test purpose;

<group> : indicates to which group the TP belongs;

<iut> : indicates the type of IUT, i.e. API or APPL;

<x> : indicates the type of testing, i.e. behaviour valid tests (BV) or behaviour invalid tests (BI);

<nn> : indicates the sequential TP number (01 to 99).

The naming conventions are as described in Table 3.

Table 3 — TP naming convention

Identifier: TP_<group>_<iut>_<x>-<nn>		
<group>		
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	API	Front End Communications API
	APPL	Front End Application
<x> = type of testing	BV	Behaviour Valid Tests
	BI	Behaviour Invalid Tests
<nn> = sequential number	(01 to 99)	Test Purpose Number

5.4 Protocol Conformance Test Report (PCTR)

The supplier of the Front End is responsible for providing a conformance test report.

The supplier of the Front End Communications API should complete the Protocol Conformance Test Report (PCTR) proforma as defined in Annex C.

The supplier of the Front End Application should complete the Protocol Conformance Test Report (PCTR) proforma as defined in Annex D.

Annex A
(informative)

Test purposes (TP) for Front End Communications API

A.1 Overview

This annex contains the test purposes (TP) for the conformity evaluation of Front End Communications to ISO 17575-2.

A.2 TP symbols conventions

A special notation and symbol convention is used, as defined in this subclause.

Definitions of the symbols used in the description of the TPs are provided in Table A.1.

Table A.1 — Description of TP Symbols

Symbol	Description
XXX(Type1 = value1) ⇒	The tester executes an XXX method of FE Communications API with argument Type1 having a value of value1. Value1 is stored in the tester's memory for further TP processing.
⇐ R:ReturnedType	The IUT returns a value of type ReturnedType.
⇐ C:CallbackName (Type1)	The IUT provides a callback CallbackName receiving variable of type Type1.
Type ISO 17575-2	Anytime Type defined in ISO 17575-2 is used. It means a variable of Type.
A → B	A “is transformed” into B.
Ø	Means “empty” or “not set”.
A | B	A or B
A ! = B	A is not equal to B.
i = i + 1	Increment variable i by 1.

In testing the Front End Communications API, it is needed to trigger operations and observe the IUT feedback both from the Front End Application and remote end (i.e. Back End) perspective. Thus, there are two test points located as shown in Figure A.1.

Application emulation test point is used directly with the IUT and emulates the Front End Application layer. It is identified in the following test purposes by the AppEm discriminator.

Remote End emulation test point is linked with the IUT over communications channel. Depending on the test purposes, it emulates application, presentation and session layer. It is identified in the following test purposes by the RemEnd discriminator.