INTERNATIONAL STANDARD

ISO 17575-2

First edition
2016-01-15

Electronic fee collection — Application interface definition for autonomous systems —

Part 2: Communication and connection to the lower layers

Perception du télépéage — Définition de l'interface d'application pour les systèmes autonomes —

Partie 2: Communications et connexions aux couches basses

Reference number
ISO 17575-2:2016(E)

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

This edition of ISO 17575-2 cancels and replaces ISO/TS 17575-2:2010, which has been technically revised. The following changes have been made:

— conversion from a Technical Specification to an International Standard;

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

ISO 17575 consists of the following parts, under the general title *Electronic fee collection — Application interface definition for autonomous systems*:

— *Part 1: Charging*

— *Part 2: Communication and connection to the lower layers*

— *Part 3: Context data*

In this edition of the ISO 17575-series the contents of ISO/TS 17575-4:2011 were incorporated into ISO 17575-3:2016. ISO/TS 17575-4:2011 will be withdrawn once ISO 17575-3 has been published.

Introduction

0.1 Autonomous systems

ISO 17575 is a series of standards defining the information exchange between the Front End and the Back End in electronic fee collection (EFC) based on autonomous on-board equipment (OBE). EFC systems automatically collect charging data for the use of road infrastructure including motorway tolls, zone-based fees in urban areas, tolls for special infrastructure like bridges and tunnels, distance-based charging and parking fees.

Autonomous OBE operates without relying on dedicated road-side infrastructure by employing wide-area technologies such as Global Navigation Satellite Systems (GNSS) and Cellular Networks (CN). These EFC systems are referred to by a variety of names. Besides the terms autonomous systems and GNSS/CN systems, the terms GPS/GSM systems and wide-area charging systems are also in use.

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.

Two strengths of the autonomous approach to electronic fee collection are its flexibility, allowing the implementation of almost all conceivable charging principles, and its independence from local infrastructure, thereby predisposing this technology towards interoperability across charging systems and countries. Interoperability can only be achieved with clearly defined interfaces, which is the aim and justification of ISO 17575.

0.2 Business architecture

This part of ISO 17575 complies with the business architecture defined in ISO 17573. According to this architecture, the toll charger is the provider of the road infrastructure and, hence, the recipient of the road usage charges. The toll charger is the actor associated with the toll charging role (see Figure 1).

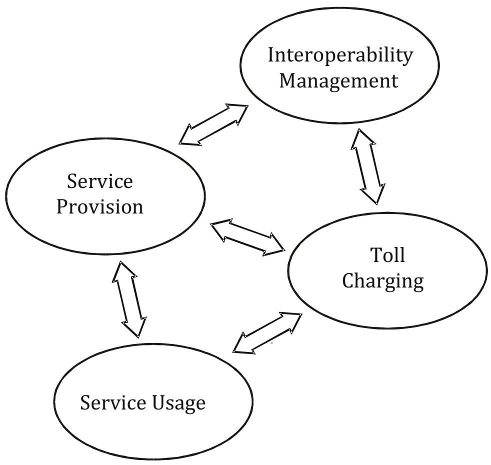

Figure 1 — The role-based model underlying ISO 17575

Service providers issue OBE to the users of the road infrastructure. Service providers are responsible for operating OBE that will record the amount of road usage in all toll charging systems the vehicle passes through and for delivering the charging data to the individual toll chargers. In general, each service provider delivers charging data to several toll chargers and, in general, each toll charger receives charging data from more than one service provider. Interoperability management, as shown in Figure 1, comprises all specifications and activities that define and maintain a set of rules that govern the overall toll charging environment.

0.3 Technical architecture

The technical architecture of Figure 2 is independent of any particular practical realization. It reflects the fact that some processing functionalities can either be allocated to the OBE or to an associated off-board component (proxy). An example of processing functionality that can be realized either on- or off-board is map-matching, where the vehicle locations in terms of measured coordinates from GNSS are associated to geographic objects on a map that either reside on- or off-board. Also, the computation of tariffs can be done with OBE tariff tables and processing, or with an off-board component.

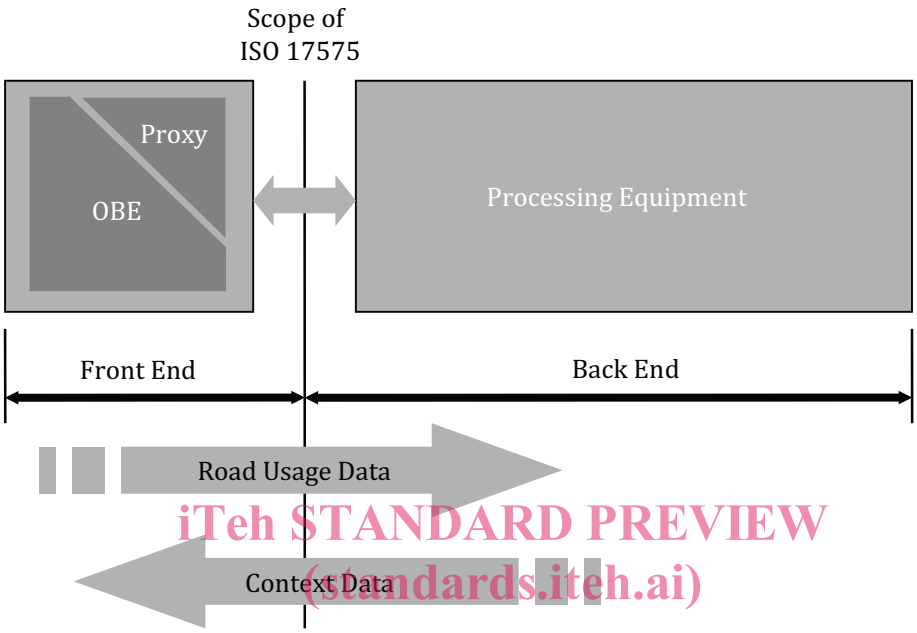

Figure 2 — Assumed technical architecture and interfaces

The combined functionality of OBE and proxy is denoted as Front End. A Front End implementation where processing is predominately on the OBE-side is known as a smart client (or intelligent client, fat client) or edge-heavy. A Front End where processing is mostly done off-board is denoted as thin-client or edge-light architecture. Many implementations between the "thin" and "thick" extremes are possible, as depicted by the gradual transition in the wedges in Figure 2. Both extremes of architectural choice have their merits and are one means where manufacturers compete with individual allocations of functionality between on-board and central resources.

Especially for thin client OBE, manufacturers might devise a wide variety of optimizations of the transfer of localization data between OBE and off-board components, where proprietary algorithms are used for data reduction and data compression. Standardization of this transfer is neither fully possible nor beneficial.

0.4 Location of the specification interface

In order to abstract from, and become independent of, these architectural implementation choices, the primary scope of ISO 17575 is the data exchange between Front End and Back End (see the corresponding vertical line in Figure 2). For every toll regime, the Back End will send context data, i.e. a description of the toll regime in terms of charged objects, charging rules and, if required, the tariff scheme to the Front End, and will receive usage data from the Front End.

It has to be noted also that the distribution of tasks and responsibilities between service provider and toll charger will vary individually. Depending on the local legal situation, toll chargers will require "thinner" or "thicker" data, and might or might not leave certain data processing tasks to service providers. Hence, the data definitions in ISO 17575 may be useful on several interfaces.

ISO 17575 also provides for basic media-independent communication services that may be used for communication between Front End and Back End, which might be line-based or an air-link, and can also be used for the air-link between OBE and central communication server.

0.5 The parts of ISO 17575

Part 1: Charging, defines the attributes for the transfer of usage data from the Front End to the Back End. The contents of charge reports might vary between toll regimes, hence, attributes for all requirements are offered, ranging from attributes for raw localization data, for map-matched geographic objects and for completely priced toll transactions. A toll regime comprises a set of rules for charging, including the charged network, the charging principles, the liable vehicles and a definition of the required contents of the charge report.

Part 2: Communication and connection to lower layers, defines basic communication services for data transfer over the OBE air-link or between Front End and Back End. The data defined in ISO 17575-1 and ISO 17575-3 can but need not be exchanged using the communication stack as defined in ISO 17575-2.

Part 3: Context data, defines the data to be used for a description of individual charging systems in terms of charged geographical objects and charging and reporting rules. For every toll charger's system, attributes as defined in ISO 17575-3 are used to transfer data to the Front End in order to instruct it on which data to collect and report.

0.6 Application needs covered by ISO 17575

The ISO 17575 series of standards

- is compliant with the architecture defined in ISO 17573:2010,
- supports charges for use of road sections (including bridges, tunnels, passes, etc.), passage of cordons (entry/exit) and use of infrastructure within an area (distance, time),
- supports fee collection based on units of distance or duration, and based on occurrence of events,
- supports modulation of fees by vehicle category, road category, time of usage and contract type (e.g. exempt vehicles, special tariff vehicles, etc.),
- supports limiting of fees by a defined maximum per period of usage,
- supports fees with different legal status (e.g. public tax, private toll),
- supports differing requirements of different toll chargers, especially in terms of
  - geographic domain and context descriptions,
  - contents and frequency of charge reports,
  - feedback to the driver (e.g. green or red light), and
  - provision of additional detailed data on request, e.g. for settling of disputes,
- supports overlapping geographic toll domains,
- supports adaptations to changes in
  - tolled infrastructure,
  - tariffs, and
  - participating regimes, and
- supports the provision of trust guarantees by the service provider to the toll charger for the data originated from the Front End.

Electronic fee collection — Application interface definition for autonomous systems —

Part 2: Communication and connection to the lower layers

1 Scope

This part of ISO 17575 defines how to convey all or parts of the data element structure defined in other parts of ISO 17575 over any communication stack and media suitable for this application. It is applicable only to mobile communication links (although wired links, i.e. back office connections, can use the same methodology).

To establish a link to a sequence of service calls initializing the communication channel, addressing the reception of the message and forwarding the payload are required. The definition provided in this part of ISO 17575 includes the required communication medium independent services, represented by an abstract application programming interface (API).

The communication interface is implemented as an API in the programming environment of choice for the Front End (FE) system. The specification of the Back End (BE) API is outside the scope of this part of ISO 17575.

The definition of this API in concrete terms is outside of the scope of this part of ISO 17575. This part of ISO 17575 specifies an abstract API that defines the semantics of the concrete API as illustrated in Figure 3 and its protocol implementation conformance statement (PICS) proforma (see Annex B). An example of a concrete API is presented in Annex C. Where no distinction is made between the abstract and concrete communications APIs, the term "communications API" or just "API" can be used.

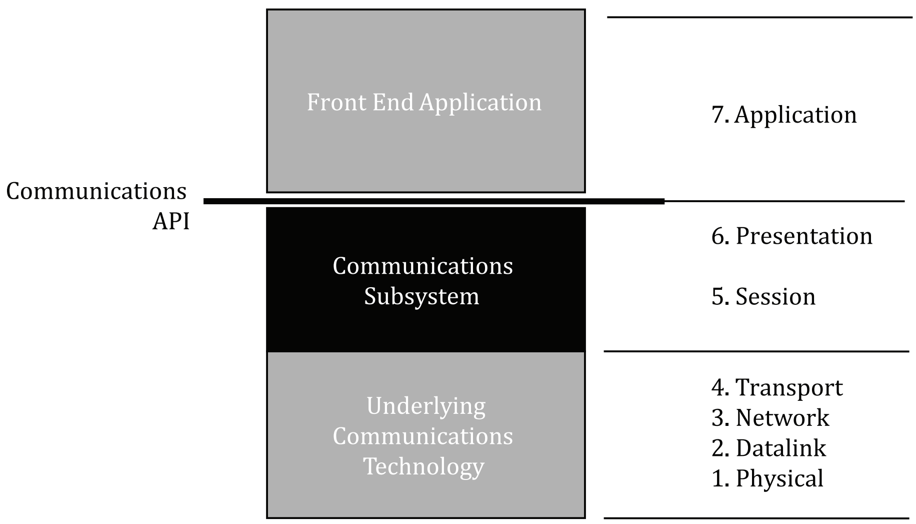

Figure 3 — Scope of this part of ISO 17575

This part of ISO 17575 also provides a detailed specification for the structure of associated API statements, an example on how to implement it and its role in a complex toll cluster such as the EETS (see Annex A to Annex E).

Media selection policies, certificate handling and encryption mechanisms are outside of the scope of this part of ISO 17575.

2 Terms and definitions

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

2.1
attribute
addressable package of data consisting of a single data element or structured sequences of data elements

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

2.2
authenticator
data, possibly encrypted, that is used for authentication

[SOURCE: EN 15509:2014, 3.3]

2.3
Back End
BE
part of a back office system interfacing to one or more *Front Ends* (2.6)

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

2.4
data element
coded information, which might itself consist of lower level information structures

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

2.5
data integrity
property that data has not been altered or destroyed in an unauthorized manner

2.6
Front End
FE
part of a tolling system consisting of an *OBE* (2.9) and possibly a *proxy* (2.10) where road tolling information and usage data are collected and processed for delivery to the *Back End* (2.3)

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

Note 1 to entry: The Front End comprises the *on-board equipment* (2.9) and an optional *proxy* (2.9).

2.7
Front End application
part of the Front End above the API

2.8
interoperability
ability of systems to exchange information and to make mutual use of the information that has been exchanged

[SOURCE: ISO/IEC/TR 10000-1:1998, 3.2.1, modified.]

2.9
on-board equipment
OBE
all required equipment on-board a vehicle for performing required EFC functions and communication services

Note 1 to entry: Other sub-units should be considered optional.

2.10
proxy
optional part of a *Front End* (2.6) that communicates with external equipment and processes the data received into an agreed format to be delivered to the *Back End* (2.3)

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

2.11
service primitive
elementary communication service provided by the application layer protocol to the application processes

Note 1 to entry: The invocation of a service primitive by an application process implicitly calls upon and uses services offered by the lower protocol layers.

[SOURCE: ISO 14906:2011, 3.18, modified — the subject has been deleted.]

2.12
toll service provider
entity providing toll services in one or more toll domains

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

2.13
toll
charge, tax or duty levied in connection with using a vehicle in a toll domain

[SOURCE: ISO/TS 19299:2015, 3.42, modified — “any” has been deleted from before “charge”.]

Note 1 to entry: The definition is the generalization of the classic definition of a toll as a charge, a tax, or a duty for permission to pass a barrier or to proceed along a road, over a bridge, etc. The definition also includes fees regarded as an (administrative) obligation, e.g. a tax or a duty.

2.14
toll charger
entity which levies toll for the use of vehicles in a toll domain

[SOURCE: ISO 17573:2010, 3.16, modified — “legal” has been deleted from before “entity” and “the use of” has been added.]

3 Abbreviated terms

For the purpose of this document, the following abbreviated terms apply unless otherwise specified.

ADU	Application data unit (ISO 14906)
APDU	Application protocol data unit (ISO 14906)
AP	Application process (ISO 14906)
API	Application programming interface
ASN.1	Abstract Syntax Notation One (ISO/IEC 8824-1)

BE	Back End
CN	Cellular network
EID	Element identifier (ISO 14906)
FE	Front End
GNSS	Global Navigation Satellite System
OBE	On-board equipment (ISO 14906)
VAT	Value added tax

4 EFC Front End communication architecture

4.1 General

A communications subsystem is required to establish the communication link between a Front End (FE) and a Back End (BE) Application. It provides data transport for the tolling FE Application via the communications session that takes part across the line shown in Figure 4. In cases where a proxy is present in the FE system, the communications subsystem defines the communications between the BE and the proxy. The link between the proxy and the on-board equipment (OBE) is out of the scope of this part of ISO 17575. In cases where no proxy is present (the "smart client"), the communications subsystem defines the communications between the OBE and the BE.

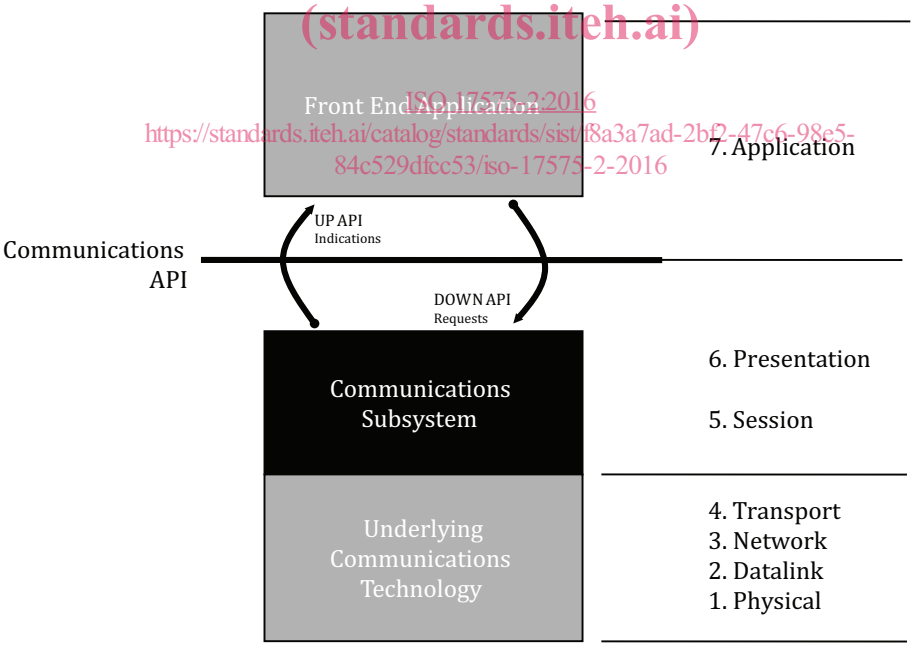

Figure 4 — Relationship between Application and Protocol Stack

The communications subsystem is further subdivided into two distinct components. The communications API itself offers communications functionality to the FE Application. Below this is the underlying communications technology, which provides the functionality that the API abstracts. Although the API is independent of the underlying technology, it does place a number of functional demands upon it. For this reason, the functional requirements on the underlying communications technology are listed in 6.2.