TECHNICAL SPECIFICATION

ISO/TS 17575-2

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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 plus basses

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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 document:

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— 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order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn.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again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.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 17575-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Road transport and traffic telematics,* in collaboration with Technical Committee ISO/TC 204, *Intelligent transport systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO/TS 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*

— *Part 4: Roaming*

Introduction

Autonomous systems

This part of ISO/TS 17575 is part of a series of specifications 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 Communications Networks (CN). These EFC systems are referred to by a variety of names. Besides the terms autonomous systems and GNSS/CN systems, also the terms GPS/GSM systems, and wide-area charging systems are 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.

Some of the 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/TS 17575.

Business architecture

This part of ISO/TS 17575 complies with the business architecture defined in the draft of the future International Standard 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.

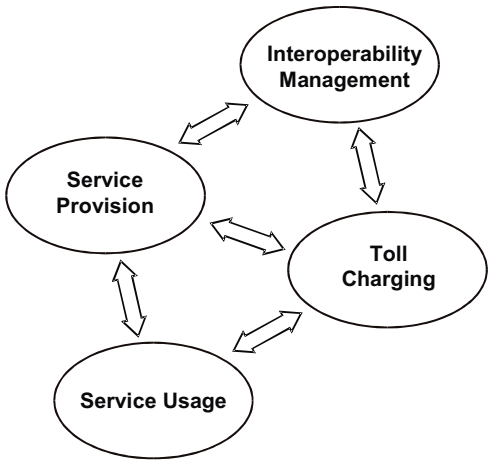

Figure 1 — The rolebased model underlying this Technical Specification

Service Providers issue OBE to the users of the road infrastructure. Service Providers are responsible for operating the 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, as well as each Toll Charger in general receives charging data from more than one Service Provider. Interoperability Management in Figure 1 comprises all specifications and activities that, in common, define and maintain a set of rules that govern the overall toll charging environment.

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 tariffication can be done with OBE tariff tables and processing, or with an off-board component.

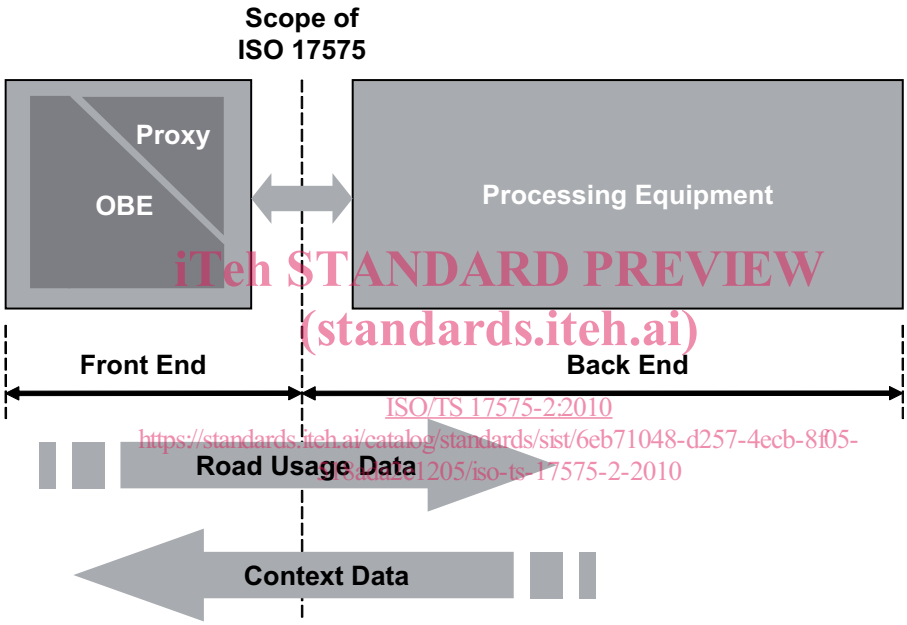

Figure 2 — Assumed technical architecture and interfaces

The combined functionality of OBE and Proxy is denoted as Front End. A Front End implementation where processing is predominately on 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 choices 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.

Location of the specification interface

In order to abstract from, and become independent of, these architectural implementation choices, the primary scope of ISO/TS 17575 is the data exchange between Front End and Back End (see the corresponding dotted 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/TS 17575 may be useful on several interfaces.

ISO/TS 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.

The parts of ISO/TS 17575

Part 1: Charging, defines the attributes for the transfer of usage data from the Front End to the Back End. The required attributes will differ from one Toll Charger to another, 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.

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.

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 part 3 are used to transfer data to the Front End in order to instruct it which data to collect and report.

Part 4: Roaming, defines the functional details and data elements required to operate more than one EFC regime in parallel. The domains of these EFC regimes may or may not overlap. The charge rules of different overlapping EFC regimes can be linked, i.e. they may include rules that an area pricing scheme will not be charged if an overlapping toll road is used and already paid for.

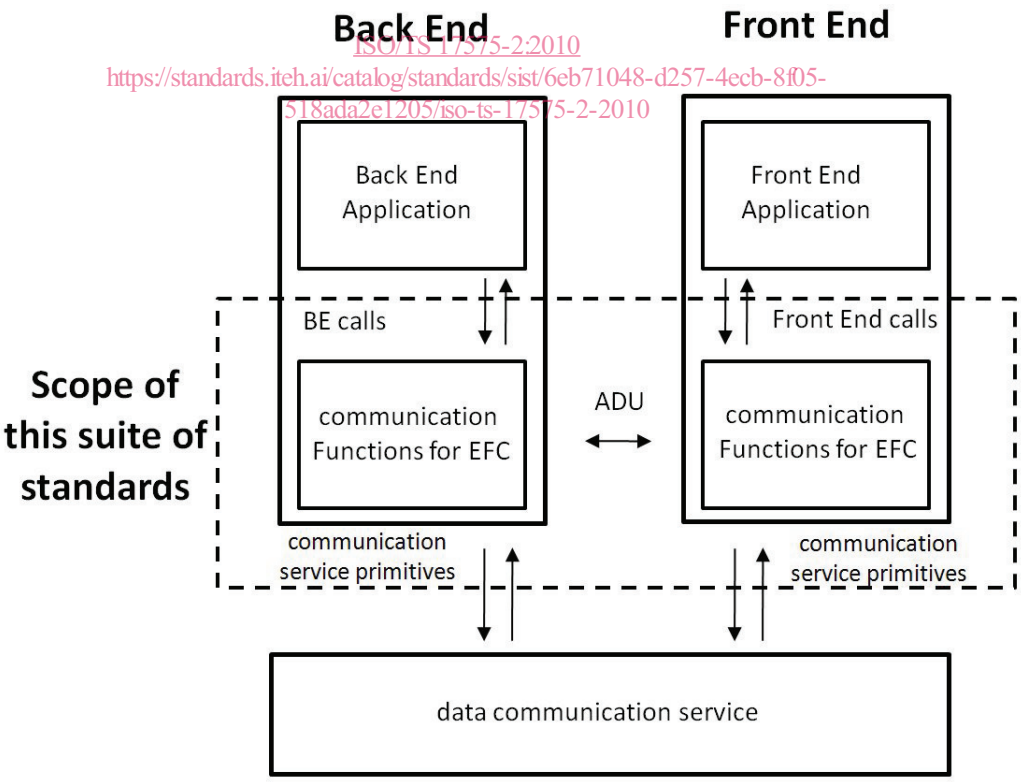

Figure 3 — Scope of ISO/TS 17575

Applicatory needs covered by ISO/TS 17575

— The parts of ISO/TS 17575 are compliant with the architecture defined in the future International Standard ISO 17573.

— The parts of ISO/TS 17575 support 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).

— The parts of ISO/TS 17575 support fee collection based on units of distance or duration, and based on occurrence of events.

— The parts of ISO/TS 17575 support modulation of fees by vehicle category, road category, time of usage and contract type (e.g. exempt vehicles, special tariff vehicles, etc.).

— The parts of ISO/TS 17575 support limiting of fees by a defined maximum per period of usage.

— The parts of ISO/TS 17575 support fees with different legal status (e.g. public tax, private toll).

— The parts of ISO/TS 17575 support 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.

— The parts of ISO/TS 17575 support overlapping geographic toll domains.

— The parts of ISO/TS 17575 support adaptations to changes in

  — tolled infrastructure,

  — tariffs, and

  — participating regimes.

— The parts of ISO/TS 17575 support 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/TS 17575 defines how to convey all or parts of the data element structure defined in ISO/TS 17575-1 over any communication stack and media suitable for this application. It is focussed on mobile communication links. However, wired links shall 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 required communication medium independent services are part of the definition of this part of ISO/TS 17575, represented by an abstract API.

The communication interface shall be implemented as an API in the programming environment of choice for the Front End (FE) system. The definition of this API in concrete terms is outside of the scope of this part of ISO/TS 17575. This part of ISO/TS 17575 specifies an abstract API that defines the semantics of the concrete API. An example 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.

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/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Part 1*

ISO 14906:2004, *Road transport and traffic telematics — Electronic fee collection — Application interface definition for dedicated short-range communication*

3 Terms and definitions

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

3.1
attribute
application information formed by one or by a sequence of data elements, used for implementation of a transaction

3.2
authenticator
data appended to, or a cryptographic transformation of, a data unit that allows a recipient of the data unit to prove the source and/or the integrity of the data unit and protect against forgery

[ISO 14906:2004, definition 3.4]

3.3
Back End
generic name for the computing and communication facilities of the Service Provider and/or the Toll Charger

3.4
data element
datum which might itself consist of lower level data elements

3.5
data integrity
property that data has not been altered or destroyed in an unauthorized manner

[ISO 14906:2004, definition 3.10]

3.6
Front End
part(s) of the toll system where road usage data for an individual road user are collected, processed and delivered to the Back End

NOTE The Front End comprises the on-board equipment and an optional proxy.

3.7
Front End application
part of the Front End above the API

3.8
interoperability
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

3.9
on-board equipment
OBE
equipment located within or on the outside of the vehicle and supporting the information exchange across the interfaces of its sub-units, composed of the On Board Unit (OBU)

NOTE Other sub-units should be considered optional.

3.10
proxy
optional component part of the Front End that communicates with on-board equipment and processes road-usage data into a format compliant with this Technical Specification and delivers the data to the Back End

3.11
road
any stretch of land that can be navigated by a vehicle

3.12
service primitive (communication)
elementary communication service provided by the Application layer protocol to the application processes

[ISO 14906:2004, definition 3.16]

NOTE The invocation of a service primitive by an application process implicitly calls upon and uses services offered by the lower protocol layers.

3.13
service provider (toll)
legal entity providing its customers with toll services in one or more toll domains for one or more classes of vehicle

3.14
system
something of interest as a whole or as comprised of parts

NOTE A system can be referred to as an entity. A component of a system can itself be a system, in which case it can be called a subsystem.

3.15
tarrification
calculation of the tariff

3.16
toll
charge, tax, fee or duty in connection with using a vehicle within a toll domain

NOTE 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 above also includes fees regarded as an (administrative) obligation, e.g. a tax or a duty.

3.17
toll charger
legal entity charging toll for vehicles in a toll domain

3.18
user
generic term used for the customer of a Toll Service Provider, one liable for toll, the owner of the vehicle, a fleet operator, a driver, etc. depending on the context

4 Abbreviations

For the purpose of this document, the following abbreviations 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 (See ISO/IEC 8824-1.)

— **BE** Back End

— **EFC** Electronic Fee Collection (ISO 14906); here used equivalently to the term toll

— **EID** Element Identifier (ISO 14906)

— **FE** Front End

— **GNSS** Global Navigation Satellite System

— **VAT** Value added tax

5 EFC Front End communication architecture

5.1 General

The communications subsystem is required to establish the communication link between a Front End (FE) Application and a Back End (BE). It provides data transport for the tolling FE Application via the

communications session that takes part across the line in Figure 4. For the case where a proxy is present in the Front End system the communications subsystem defines the communications between the BE and the Proxy. The link between the Proxy and the OBE is out of scope. For the case that no Proxy is present (the “Fat Client”) the communications subsystem defines the communications between the OBE and the BE.

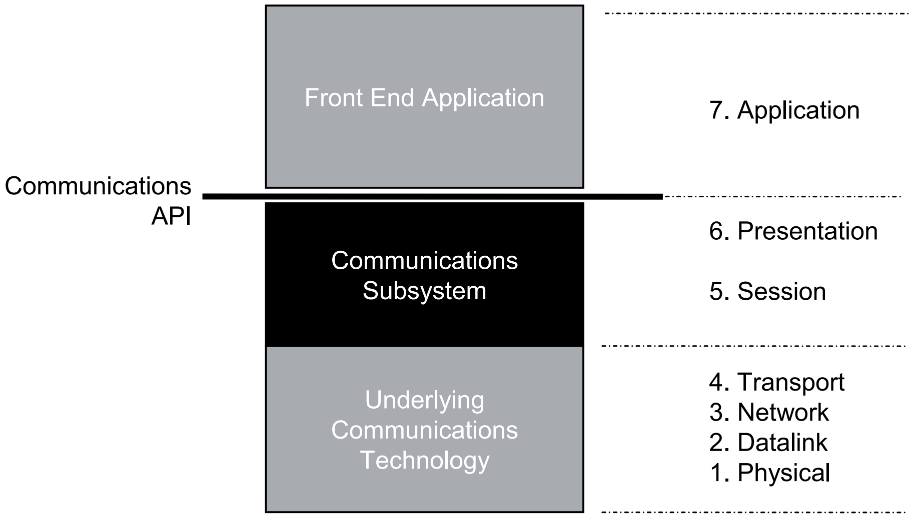

Figure 4 — Relationship between Application and Protocol Stack

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 8.2.

Some underlying technologies will be much more capable than others. For the case where a very capable technology is in use, the code interfacing the API to the underlying technology will serve little more function than a simple pass through. For more simplistic transport technologies the communications subsystem will have to do considerably more.

It is expected that these APIs will be “reflected” in the BE such that FEs and BEs can communicate over arbitrary bearer infrastructures. The specification of the BE API is outside the scope of this part of ISO/TS 17575.

5.2 Relations to the overall EFC architecture

The communications API provides the lower layers of the interface shown in Figure 5. The API has no semantic knowledge of the ADUs that it is carrying. It does differentiate between “standard specific” and “arbitrary” ADUs but it has no semantic knowledge about what these mean and simply carries them as transparent octet streams atop an arbitrary bearer that is selected at runtime.

6 Initialize transactions

6.1 General

The API carries two “types” of message (ADU). Structured elements relating directly to the definitions in ISO/TS 17575-1, and unstructured elements which are outside of the scope of this part of ISO/TS 17575 and receive no further consideration within it.

