TECHNICAL SPECIFICATION

ISO/TS 17575-1

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Electronic fee collection — Application interface definition for autonomous systems —

Part 1: Charging

Perception du télépéage — Définition de l'interface d'application pour les systèmes autonomes —
Partie 1: Imputation

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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:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— 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order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn.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again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.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 17575-1 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.

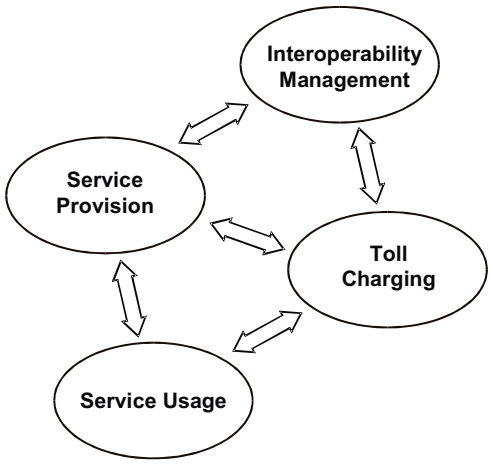

Figure 1 — The rolebased model underlying this Technical Specification

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

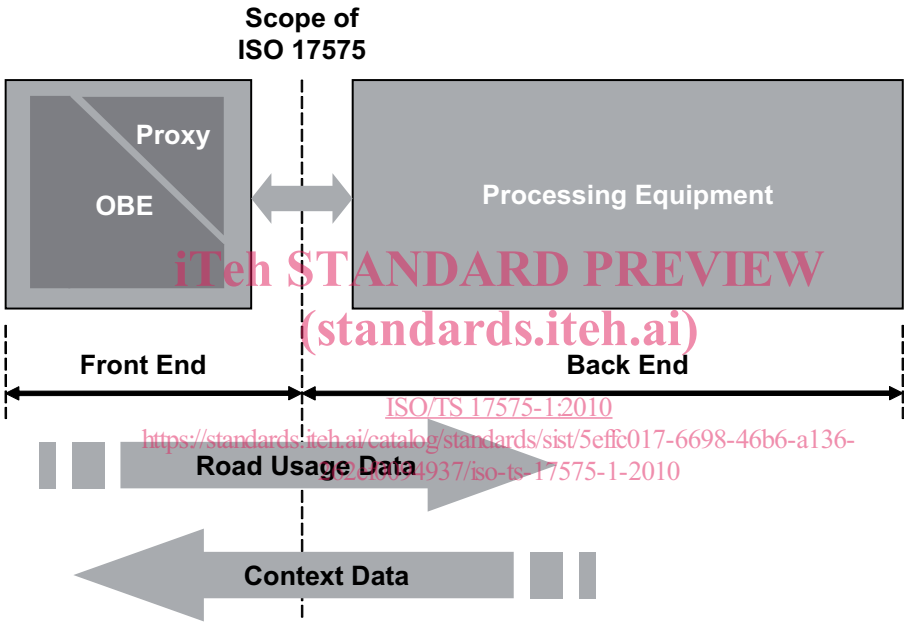

Figure 2 — Assumed technical architecture and interfaces

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.

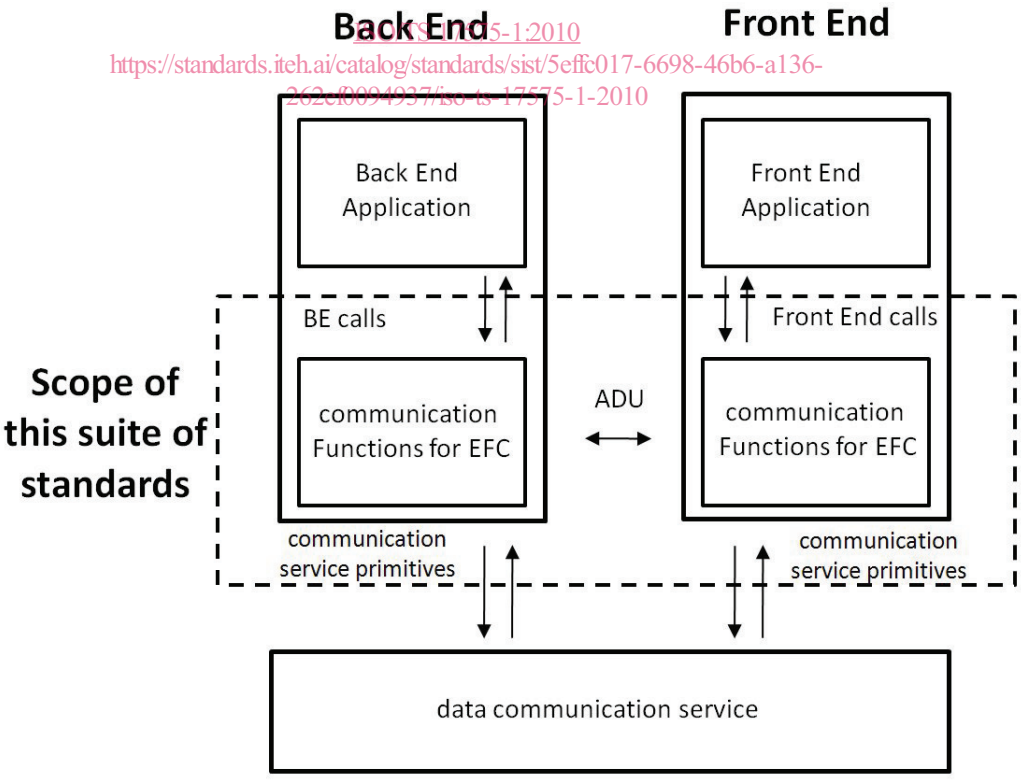

Figure 3 — Scope of ISO/TS 17575

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),

  — 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 1: Charging

1 Scope

This part of ISO/TS 17575 defines the format and semantic of the data exchange between a Front End (OBE plus optional proxy) and corresponding Back Ends in autonomous toll regimes. This part of ISO/TS 17575 deals with the definition of the data elements used to report charging details from the Front End to the Back End and to receive data which can be used to re-configure the ongoing process of gathering charge relevant information in the Front End.

The constitution of the charge report is dependent on configuration data that are assumed to be present in the Front End. The assembly of charge reports can be configured for each individual toll regime according to local needs. Charge reports generated in accordance with this part of ISO/TS 17575 are consistent with the requirements derived from the current architectural concept favoured in the relevant standardization bodies.

NOTE An EFC architecture standard is currently under development and is to be published in ISO 17573.

The data defined in this part of ISO/TS 17575 are used to generate charge reports that contain information about the road usage of a vehicle for certain time intervals. The contents of these charge reports might vary between toll regimes. 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.

The data defined in this part of ISO/TS 17575 are exchanged using an open definition of a communication stack as defined in ISO/TS 17575-2.

The definitions in this part of ISO/TS 17575 comprise:

— reporting data, i.e. data for transferring road usage data from Front End to Back End, including a response from the Back End towards the Front End;

— contract data, i.e. data for identifying contractually essential entities;

— road usage data, i.e. data for reporting the amount of road usage;

— account data for managing a payment account;

— versioning data;

— compliance checking data, i.e. data imported from ISO/TS 12813, which are required in Compliance Checking Communications.

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 6709, *Standard representation of geographic point location by coordinates*

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

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER) — Part 2*

ISO/TS 12813, *Electronic fee collection — Compliance check communication for autonomous systems*

ISO 14906, *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.

NOTE Some terms used in this document might also be defined in the future International Standard ISO 17573. The intention is to define them consistently. However, as ISO 17573 is still under development these definitions might be aligned in future.

3.1
area pricing
charging process based on road usage occurring within a given area

3.2
attribute
application information formed by one or by a sequence of data elements, used for implementation of a transaction

3.3
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]

3.4
Back End
generic name for the computing and communication facilities of the Service Provider and/or the Toll Charger

3.5
charge report
data structure transmitted from the Front End to the Back End to report road usage data and supplementary related information

3.6
charge object
any object that is part of the toll context description that may be charged for its use under certain conditions

3.7
contract
agreement governing part of the collective behaviour of a set of objects

NOTE A contract specifies obligations, permissions and prohibitions for the objects involved.

3.8
cordon
border line of an area

3.9
cordon pricing
charging process based on registering passages of a cordon

3.10
data element
datum, which might itself consist of lower level data elements

3.11
data group
group of data elements selected by semantic relation

3.12
data integrity
property that data have not been altered or destroyed in an unauthorised manner

[ISO 14906:2004, definition 3.10]

3.13
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.

3.14
proxy
optional component 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

3.15
road
any stretch of land that can be navigated by a vehicle

3.16
road usage
travelling on a road with a vehicle

3.17
road usage data
data necessary to calculate the fees accumulated by a road user

3.18
road section tolling
processes for EFC based on charges for individual road sections

3.19
tarrification
calculation of the tariff

3.20
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.

3.21
toll cluster
group of toll schemes operating under a common agreement providing interoperability for vehicles equipped with an appropriate OBE and being contracted under a service provider being part of the cluster

3.22
toll context
logical view of a toll scheme as defined by attributes and functions

3.23
toll context data
set of data necessary to define a toll context

3.24
toll domain
area or part of a road network where a toll regime is applied

3.25
toll regime
set of rules, including enforcement rules, governing the collection of toll in a toll

3.26
toll service
service enabling users having only one contract and one set of OBE to use a vehicle in one or more toll domains

3.27
toll system
overall view of a toll scheme or toll cluster

NOTE A component of a toll system can itself be a system, in which case it may be called a toll subsystem.

3.28
transaction
whole of the exchange of information between Front End and Back End necessary for the completion of a toll operation

3.29
transaction model
functional model describing the general structure of Electronic Payment Fee Collection transactions

[ISO 14906:2004, definition 3.20]

4 Abbreviations

For the purposes of this document, the following abbreviations apply unless otherwise specified.

— **ADU** Application data unit

— **ASN.1** Abstract Syntax Notation One (See ISO/IEC 8824-1.)

— **CCC** Compliance Check Communication, as defined by ISO/TS 12813

— **CN** Cellular network

— **DSRC** Dedicated short range communication

— **EFC** Electronic Fee Collection as defined in ISO 14906; here used as an equivalent to the term toll

— **GNSS** Global Navigation Satellite Systems