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English Version

Electronic fee collection - Application interface definition for autonomous systems - Part 2: Communication and connection to the lower layers (ISO/TS 17575-2:2010)

Perception du télépéage - Définition de l'interface d'application pour les systèmes autonomes - Partie 2: Communications et connexions aux couches plus basses (ISO/TS 17575-2:2010)

Elektronische Gebührenerfassung - Anwendungsschnittstelle für autonome Systeme - Teil 2: Kommunikation und Verbindung mit den unteren Schichten (ISO/TS 17575-2:2010)

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Foreword

This document (CEN ISO/TS 17575-2:2010) has been prepared by Technical Committee CEN/TC 278 “Road transport and traffic telematics”, the secretariat of which is held by NEN, in collaboration with Technical Committee ISO/TC 204 "Intelligent transport systems".

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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.

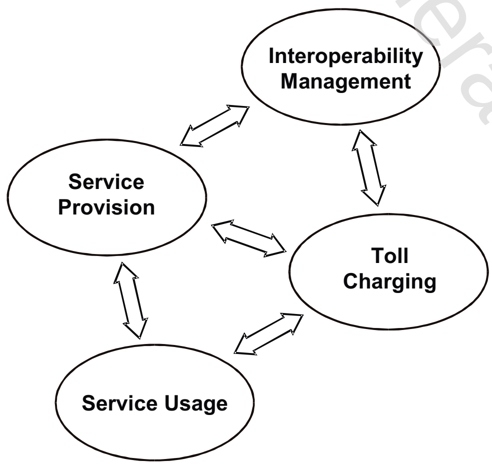

Figure 1 — The rolebased model underlying this Technical Specification

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.

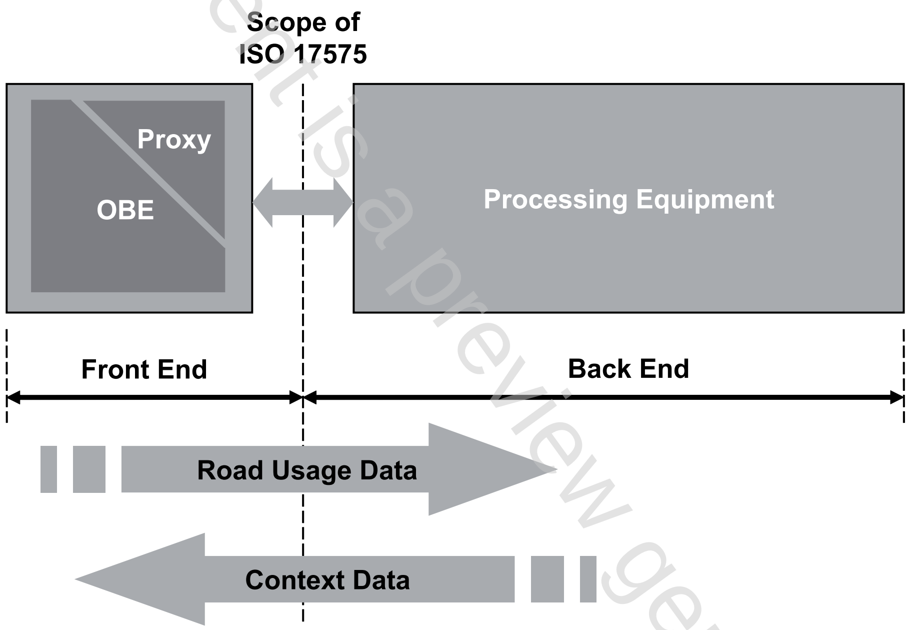

Figure 2 — Assumed technical architecture and interfaces

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.

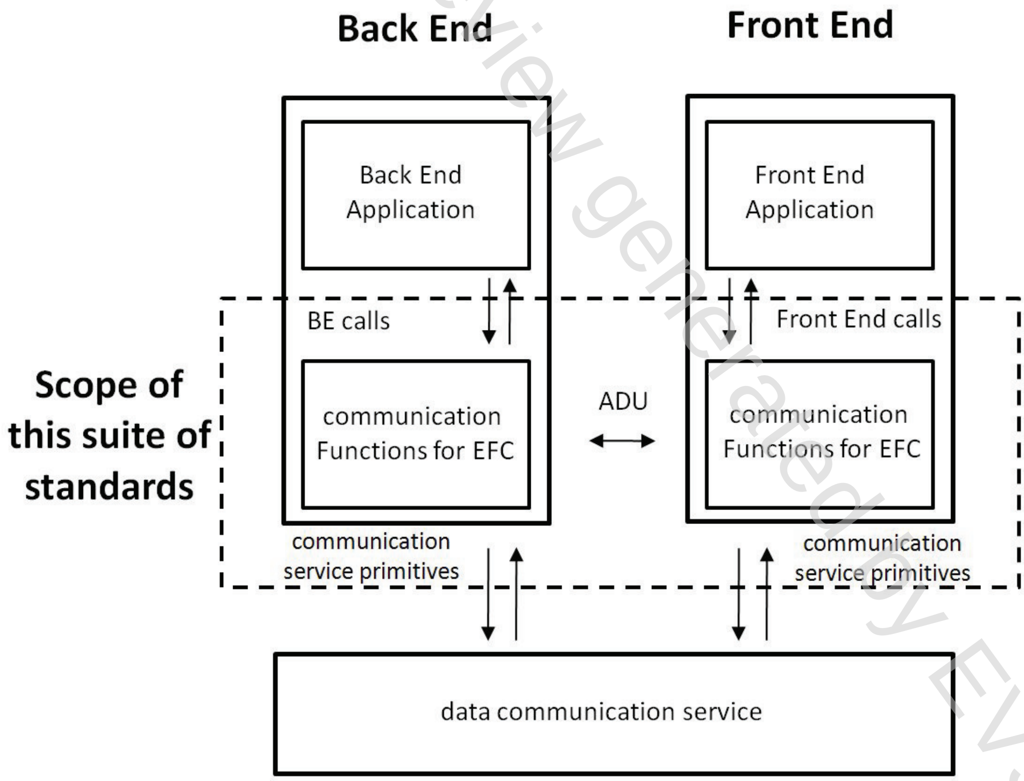

Figure 3 — Scope of ISO/TS 17575

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]

