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Vägtrafikinformatik – Elektronisk vägavgiftsupptagning – Definition av applikationsgränssnitt för autonoma system – Del 3: Kontextdata (ISO/TS 17575-3:2011)

Electronic fee collection – Application interface definition for autonomous systems – Part 3: Context data (ISO/TS 17575-3:2011)

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Electronic fee collection - Application interface definition for autonomous systems - Part 3: Context data (ISO/TS 17575-3:2011)

Perception du télépéage - Définition de l'interface d'application pour les systèmes autonomes - Partie 3: Données du contexte (ISO/TS 17575-3:2011)

Elektronische Gebührenerfassung - Anwendungsschnittstelle für autonome Systeme - Teil 3: Kontextdaten (ISO/TS 17575-3:2011)

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Foreword

This document (CEN ISO/TS 17575-3:2011) 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 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.

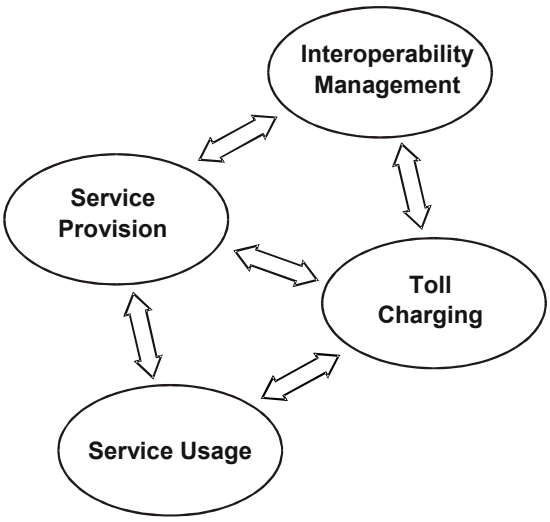

Figure 1 — The rolebased model underlying this Technical Specification

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.

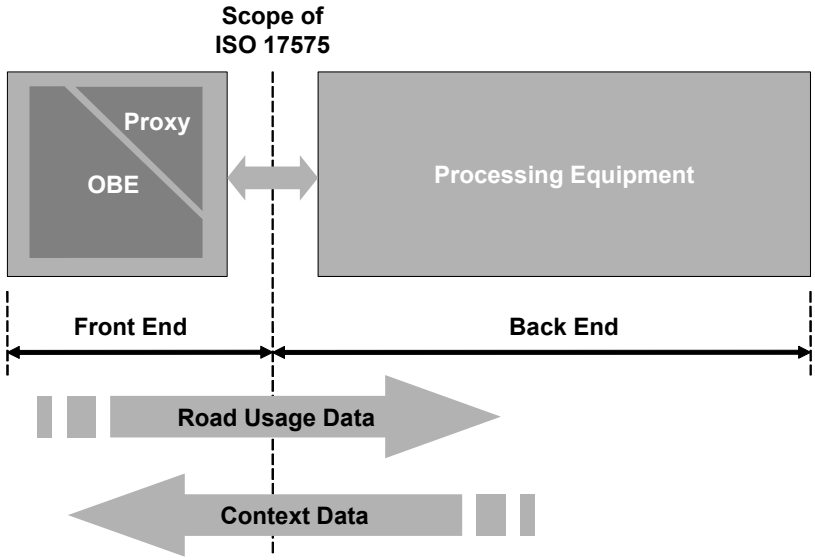

Figure 2 — Assumed technical architecture and interfaces

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 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.

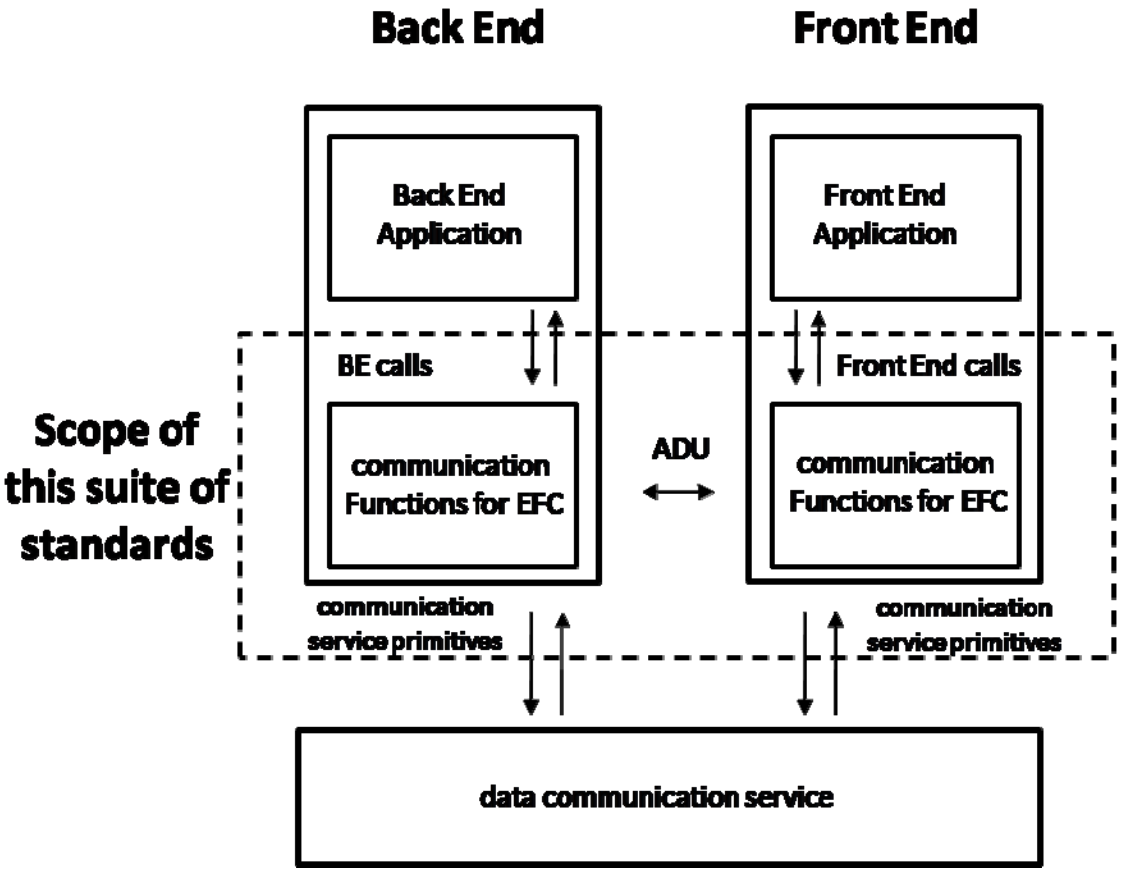

Figure 3 — Scope of ISO/TS 17575

In ISO/TS 17575, context data is the description of the properties of a single instance of an EFC context. This single instance of an EFC context operates according to one of the basic tolling principles such as

— road sectioned tolling,

— area pricing according to travelled distance,

— area pricing according to the time,

— cordon pricing.

EFC context data comprise a set of rules for charging, including the description of the charged network, the charging principles, the liable vehicles and a definition of the required contents of the charge report. This set of rules is defined individually for each EFC context according to local needs.

This part of ISO/TS 17575 contains the definitions of the above listed type of data.

Only a Front End configured with the context data necessary for the respective EFC context is able to be used for charging processes.

The following data definitions are in this part of ISO/TS 17575:

— data providing toll context overview information;

— data providing tariff information (this includes definitions of required tariff determinants like vehicle parameters, time classes and others);

— data providing context layout information;

— data providing reporting rules information.

In case one EFC domain cannot be described with a single set of context data, several of these context data are used. ISO/TS 17575-4 defines the parallel operation of more than one EFC context and how to handle interdependencies.

Applicatory needs covered by ISO/TS 17575

— The parts of ISO/TS 17575 are compliant with the architecture defined in 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 3:
Context data

1 Scope

This part of ISO/TS 17575 defines the content, semantic and format of the data exchange between a Front End (OBE plus optional proxy) and the corresponding Back End in autonomous toll systems. This part of ISO/TS 17575 comprises the definition of the data elements used to specify and describe the toll context details. Context data are transmitted from the Back End to the Front End.

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 612, *Road vehicles — Dimensions of motor vehicles and towed vehicles — Terms and definitions*

ISO 1176, *Road vehicles — Masses — Vocabulary and codes*

ISO 4217, *Codes for the representation of currencies and funds*

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

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

ISO/TS 12813:2009, *Electronic fee collection — Compliance check communication for autonomous systems*

ISO 14906:2011, *Road transport and traffic telematics — Electronic fee collection — Application interface definition for dedicated short-range communication*

ISO 17573, *Electronic Fee Collection — Systems architecture for vehicle related transport services*

ISO/TS 17575-1:2010, *Electronic fee collection — Application interface definition for autonomous systems — Part 1: Charging*

ISO/TS 17575-2:2010, *Electronic fee collection — Application interface definition for autonomous systems — Part 2: Communication and connections to the lower layers*

EN 15509, *Road transport and traffic telematics — Electronic fee collection — Interoperability application profile for DSRC*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17573 and the following apply.

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

NOTE Adapted from ISO 14906:2011.

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 14906:2011, 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
expression of an agreement between two or more parties concerning the use of the road infrastructure

[ISO 14906:2011, definition 3.7]

3.8
cordon
border line of an area

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

3.10
currencies minor unit
the minor unit of a currency (e.g. cent, pence or öre)

3.11
data element
datum, which might itself consist of lower level data elements

3.12
data integrity
property that data has not been altered or destroyed in an unauthorized manner

[ISO 7498-2:1989, definition 3.3.21]

3.13
data set
logical set of data elements selected by semantic relation

NOTE Data set is used only for better understanding and is fully independent from implementation solutions.

3.14
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.

3.15
interval scale parameters
scale of measurement of data, according to which the differences between values can be quantified in absolute but not relative terms and for which any zero is merely arbitrary

NOTE Interval scaled parameters are applicable in mathematical equations using the operators plus or minus. Interval scales having a zero offset are equal to ratio scales.

EXAMPLE The temperature scale in Celsius is an interval scale, in Kelvin it's a ratio scale.

3.16
layout
technical description of the location of a tolled object including, if applicable, auxiliary data for determining the vehicle's position relative to the tolled object

3.17
nominal scale parameters
discrete classification of data, in which data are neither measured nor ordered but subjects are merely allocated to distinct categories

NOTE Nominal scaled parameters are applicable in Boolean equations using the operators equal or not equal.

EXAMPLE A nominal scale parameter for vehicles could consist of cars, trucks, vans and motorcycles.

3.18
on-board equipment
OBE
equipment fitted within or on the outside of a vehicle and used for toll purposes

NOTE The OBE does not need to include payment means.

[ISO 14906:2011, definition 3.13]

3.19
ordinal scale parameters
scale on which data is shown simply in order of magnitude since there is no standard of measurement of differences

NOTE Ordinal scaled parameters are applicable in Boolean equations using the operators greater, greater or equal, less or less or equal.

3.20
proxy
optional component of the Front End that communicates with on-board equipment and processes road usage data into a format compliant with this part of ISO/TS 17575 and delivers the data to the Back End

3.21
ratio scale
scale of measurement of data, having a fixed zero value, which permits the comparison of differences of values

NOTE Ratio scaled parameters are applicable in mathematical equations using the operators multiplication and division.

3.22
road
any stretch of land which can be navigated by a vehicle

3.23
road usage
travelling on a road with a vehicle

3.24
road section tolling
processes for EFC based on charges for individual road sections

3.25
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.

3.26
tolled area
geographic area where a toll is applied for use of vehicles

3.27
tolled passage
location where a toll is applied for passing vehicles

3.28
tolled road
road where a toll is applied for vehicles

3.29
tolled road network
road network where a toll is applied for vehicles

3.30
tolled road section
road section where a toll is applied for vehicles

3.31
toll context
logical view of a toll scheme as defined by attributes and functions

NOTE Adapted from ISO/TS 12813:2009.

3.32
toll context data
set of data necessary to define a toll context

3.33
toll domain
area or part of a road network where a toll regime is applied

[ISO 14906:2011, definition 3.21]

3.34
toll regime
set of rules, including enforcement rules, governing the collection of toll in a toll domain

3.35
toll scheme
organizational view of a toll regime, including the group of actors of one toll domain and their relationships

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

ADU	Application data unit
ASN.1	Abstract Syntax Notation One (ISO/IEC 8824-1)
CCC	Compliance Check Communication, as defined by ISO/TS 12813:2009
CN	Cellular network
EFC	Electronic Fee Collection (ISO 14906:2011); here used equivalently to the term toll in ISO 17573
GNSS	Global Navigation Satellite Systems
HOT	High Occupancy Tolling
ID	Identifier
OBE	On Board Equipment
PICS	Protocol Implementation Conformance Statements
UTC	Coordinated Universal Time
VAT	Value added tax

5 General concept and overview

To enable a Front End to operate autonomously in a toll domain in the expected manner, a particular set of data elements containing application data has to be available to the Front End. These data elements shall contain a description of the rules which apply in a toll domain. This includes information regarding tariffs, vehicle classes, description of the charge objects and others.

The data elements shall be made available to the Front End using the communication services described in ISO/TS 17575-2.

For the purpose of data transfer an application data unit (ADU) is defined which comprises a header (mainly containing identification and data management information) and a data body (containing the application data elements itself).