DD CEN ISO/TS 17575-3:2011

Incorporating corrigendum April 2013

BSI Standards Publication

Electronic fee collection — Application interface definition for autonomous systems

Part 3: Context data (ISO/TS 17575-3:2011)

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National foreword

This Draft for Development is the UK implementation of CEN ISO/TS 17575-3:2011. It is identical to ISO/TS 17575-3:2011, incorporating corrigendum April 2013.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by ISO corrigendum April 2013 is indicated in the text by [AC1] 〈AC1〉

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature. It should be applied on this provisional basis, so that information and experience of its practical application can be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the international organization responsible for its conversion to an international standard. A review of this publication will be initiated not later than 3 years after its publication by the international organization so that a decision can be taken on its status. Notification of the start of the review period will be made in an announcement in the appropriate issue of *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into an international Standard, to extend the life of the Technical Specification or to withdra w it. Comments should be sent to the Secretary of the responsible BSI Technical Committee at British Standards House, 389 Chiswick High Road, London W4 4AL.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Road transport informatics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2011.

Amendments/corrigenda issued since publication

Date	Text affected
31 May 2013	Implementation of ISO corrigendum April 2013

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TECHNICAL SPECIFICATION

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English Version

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)

This Technical Specification (CEN/TS) was approved by CEN on 18 October 2010 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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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".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 normative 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.

ISO/TS 17575-3 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*

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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.

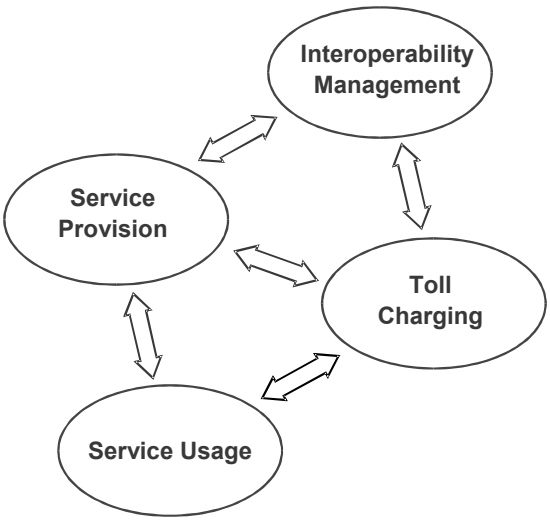

Figure 1 — The rolebased model underlying this Technical Specification

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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.

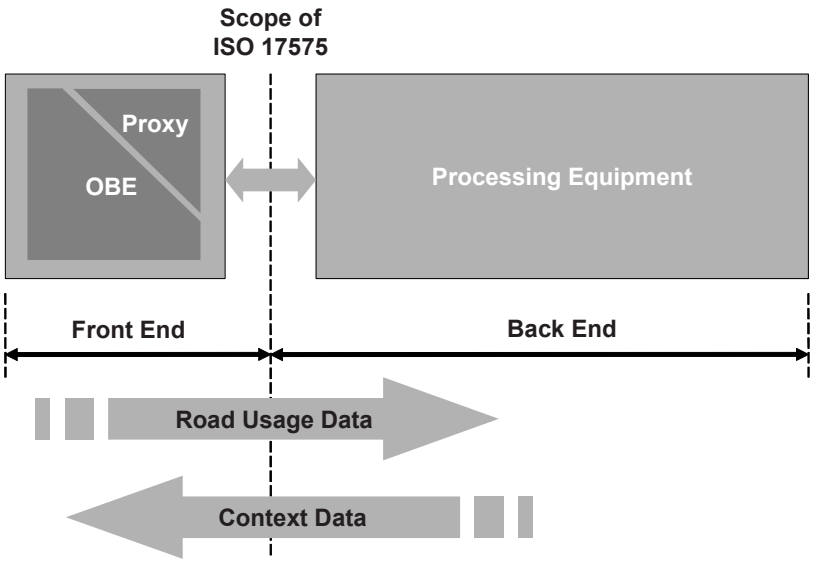

Figure 2 — Assumed technical architecture and interfaces

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.

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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.

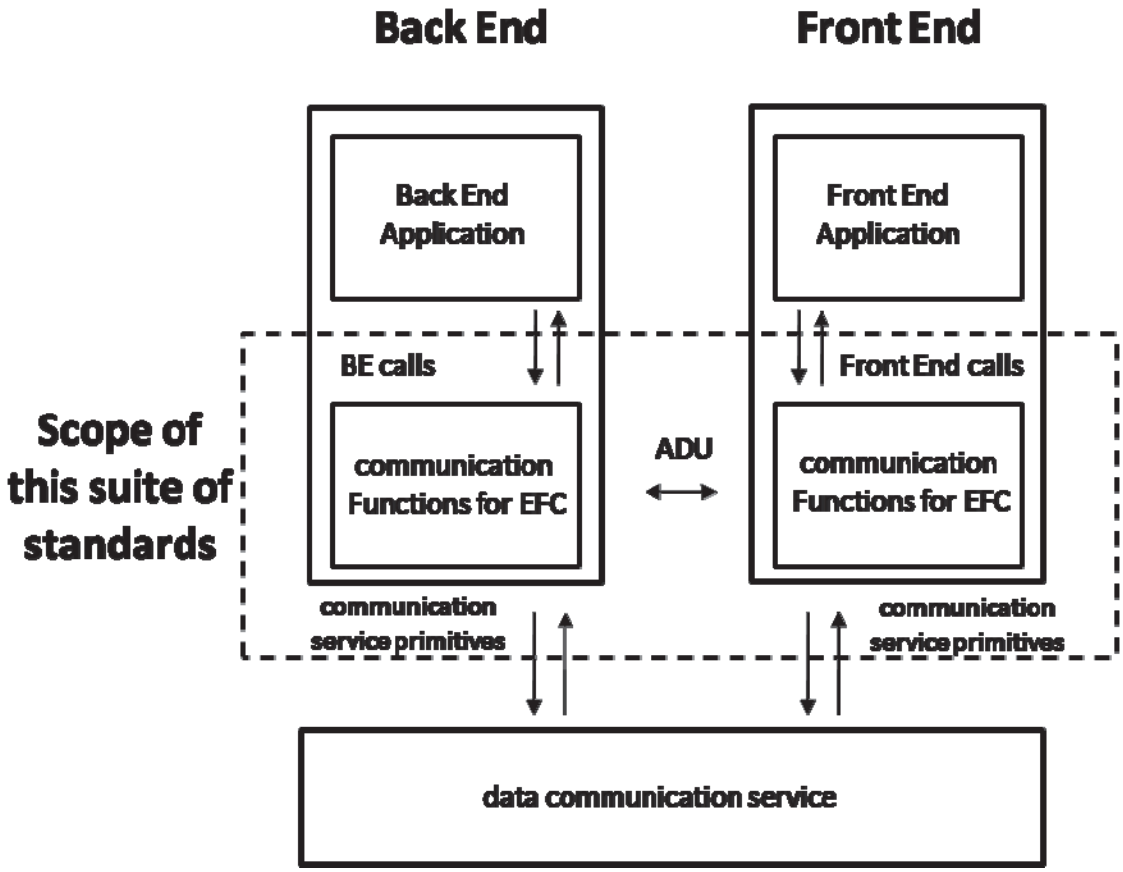

Figure 3 — Scope of ISO/TS 17575

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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,

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  - 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.

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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*

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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]

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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

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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

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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).

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The ADU header allows for identification of the data originator and the data sender. Furthermore it contains information about the EFC context to which the application data belong. Finally the ADU header carries a sequence number and an optional authenticator.

The data elements containing the EFC context description shall be dedicated to one single EFC context. To support the use of the Front End in multiple EFC contexts, the Front End may have the capability to manage multiple sets of data elements (one per EFC context) (see also Figure 4). Details regarding these “roaming” procedures and the normative requirements are defined in ISO/TS 17575-4.

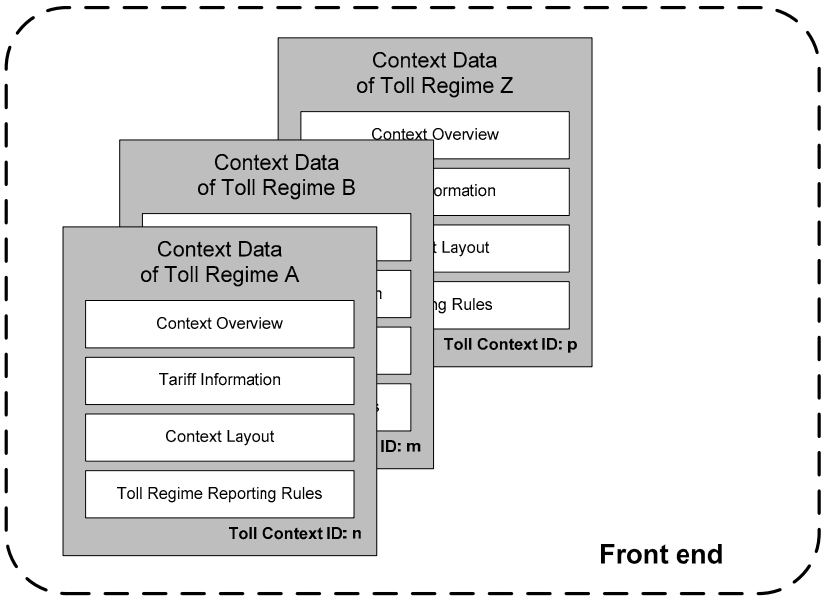

Figure 4 — Logical structure of toll context descriptions in a Front End

NOTE There may be a maximum number of toll regimes a Front End can manage. This number may depend on the memory size, the complexity of the toll regime and the envisaged use of the Front End. Front Ends may also be designed in a way to support the context description for one particular toll regime only. Other Front End designs may support context descriptions for more than one toll regime.

Context data are structured into logical data sets (refer to clause 8.2). Figure 5 gives an overview of these data sets and the type of information belonging to each data set.

Each data set comprises one or more EFC attributes. EFC attributes contain the application data. They are defined in clause 8.

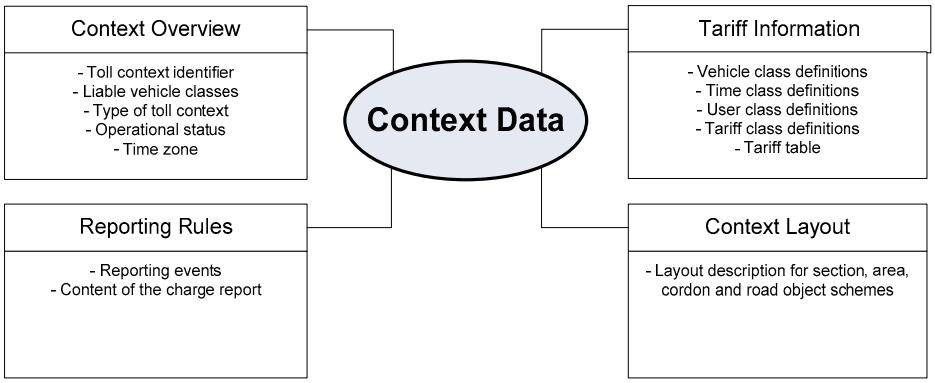

Figure 5 — Context data overview

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The organization of the memory and the physical structure of the data within a Front End are outside the scope of this part of ISO/TS 17575.

6 Procedural requirements and encoding rules

6.1 Communication services

For the purpose of transmitting ADUs from the Back End to the Front End, the communication services defined in ISO/TS 17575-2 shall be used.

6.2 Version and validity handling

Each EFC attribute carries an optional data element containing version and validity information. The data type of this data element shall always be `VersionAndValidity`. This data type shall comprise two data elements:

– `version` and

– `validFrom`.

The data element `version` shall give the version number of the respective EFC attribute. The data type shall be `VersionId` defined in ISO/TS 17575-1. The version number shall always be used in an increasing order.

NOTE 1 This concept enables the Front End to autonomously detect missing versions of context data. This may be used to initiate an action to update the respective information.

The data element `validFrom` shall give the start date and time of the validity of the respective EFC attribute. The data type shall be `DateAndTime` as defined in ISO 14906.

The information regarding version and validity of EFC attributes enables the Front End to autonomously notice the existence of new updated context data in the Back End.

NOTE 2 Once the start date and time of a context data is reached, previous versions (having a version number lower than the current one) become obsolete. The Front End may decide - depending on local settings - to initiate an action to activate the valid context data and deactivate (and delete) the previous used version(s).

The given version and validity information are exclusively valid for the EFC attribute it belongs to.

NOTE 3 This concept allows the efficient use of different versions for different types of context data. E.g. the tariff table version may be managed independently from the one valid for context layout and reporting rules. This approach reduces the amount of data to be updated.

NOTE 4 The update process itself is outside the scope of this part of ISO/TS 17575.

6.3 Encoding rules

The data types and associated coding related to the data elements described in Clauses 7 and 8 are defined using the Abstract Syntax Notation One (ASN.1) technique according to ISO/IEC 8824-1 (Annex A).

The packed encoding rules according to ISO/IEC 8825-2 shall be applied.

Octet alignment shall be used.

The distinguished encoding rules shall not apply.

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7 Application data units

7.1 Application data unit structure

For the purpose of data transfer and identification the information content shall be structured into application data units (ADU).

Each ADU shall consist of

– an ADU header and

– an ADU body.

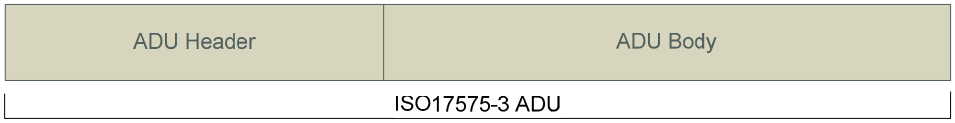

Figure 6 — Structure of an ISO 17575-3 ADU

7.2 Application data unit header

The ADU header shall consist of the data fields (Figure 7)

– information sender identifier field,

– information originator identifier field,

– toll charger identifier field

– context identifier field

– ADU sequence number field

– ADU authenticator field (optional).

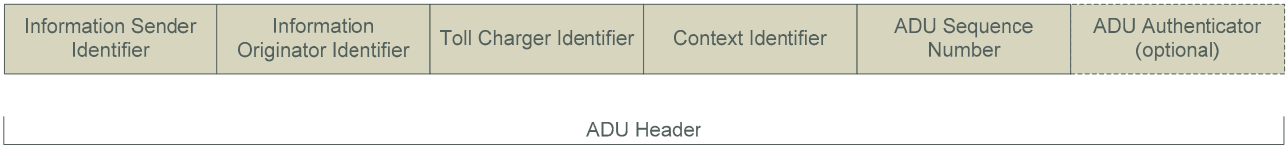

Figure 7 — Structure of the ADU header

The semantics for the data elements of the ADU header shall be according to Table 1. The data types are defined in Annex A.

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Table 1 — Data elements of the ADU Header

Data element	Data type (informative)	Definition of semantic	Remarks
informationSender	Provider	Unique identifier of the entity which has sent the data provided in the ADU body	e.g. Transport Service Provider, Toll Charger or Service Provider
informationOriginator	Provider	Unique identifier of the entity which has created the data provided in the ADU body	e.g. Transport Service Provider, Toll Charger or Service Provider
tollCharger	Provider	Unique identifier of the entity which acts as toll charger of the toll regime	Consist of country code and unique number within country
contextId	ContextId	Unique identifier for the toll context the data in the ADU body are applicable to	Consist of country code and unique number within country
aduSequenceNumber	Int4	Sequence number of the respective ADU	Shall be used in increasing order. In case of overflow, the sequence number shall restart at 0.
aduAuthenticator	Bit String	Message Authenticator	Optional

7.3 Application data unit body

The ADU body shall contain one or more EFC attributes describing the EFC context. One ADU body shall contain EFC attributes belonging to one single EFC context only.

NOTE Very complex EFC contexts (e.g. containing different types of toll schemes like a cordon pricing and a section pricing) may be split into two EFC context descriptions. Interdependencies between these multiple layout descriptions are specified in ISO/TS 17575-4.

The EFC context is identified by information given in data element `contextId` in the ADU header.

EXAMPLE 1 The ADU body contains the tariff table for the Barcelona congestion charging scheme.

EXAMPLE 2 The ADU body contains the geographic description of the road network of the truck tolling schemes applicable on highways in Hungary.

EXAMPLE 3 The ADU body contains the reporting rules applicable in the nationwide all-road charging scheme in Denmark.

EFC attributes and sections descriptions are defined in chapter 8.

8 EFC Attributes

8.1 Rules with respect to support of context data

Context data available in the Front End shall contain all information required to ensure a minimum level of functionality to either participate in the services of this toll regime or to unambiguously identify the toll regime as not valid (for the specific user, vehicle, moment in time...).

Each attribute being part of the context data shall be allocated to one single EFC context.

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8.2 Attributes and data sets

Each EFC context shall be described using one or more EFC attributes. EFC attributes shall contain all necessary information to enable proper functioning of the Front End in the respective EFC context.

To improve readability of this part of ISO/TS 17575 toll context description respectively attributes have been logically structured into data sets.

The following data sets are used:

- Regime Overview,
- Tariff Information,
- Context Layout,
- Reporting Rules.

NOTE Logical data sets are fully independent from the physical data structure in a Front End. The physical structure is implementation dependent and outside the scope of this part of ISO/TS 17575.

8.3 EFC attributes data catalogue

8.3.1 General

The following EFC attributes or a subset here of shall be available to the Front End (Table 2).

Table 2 — List of EFC attributes

EFC Attribute	Data set	Refer to
`TollContextOverview`	Context Overview	chapter 8.3.2
`TariffTable`	Tariff Information	chapter 8.3.3.2
`TariffClassDefinition`		chapter 8.3.3.3
`LocalVehicleClassDefinition`		chapter 8.3.3.4
`TimeClassDefinition`		chapter 8.3.3.5
`UserClassDefinition`		chapter 8.3.3.6
`TollContextLayout`	Context Layout	chapter 8.3.4
`ChargeReportingEvents`	Reporting Rules	chapter 8.3.5.1
`ChargeReportConfiguration`		chapter 8.3.5.2

In the following clauses, EFC attributes and data elements are specified in terms of:

- the names of the data elements forming the EFC attributes,
- the content and semantic definition of the EFC attributes and data elements,
- informative remarks, including references to other standards.

The specification of the corresponding data types in ASN.1 is provided in the normative Annex A.

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8.3.2 Data set "Context Overview"

Toll context overview information shall be represented by one single EFC attribute `TollContextOverview`.

The attribute `TollContextOverview` shall contain information about toll context identification, type of the toll scheme (e.g. section based tolling, area pricing, cordon pricing), time zone information and information regarding the operational status of the toll context.

The main purpose of the EFC attribute `TollContextOverview` is to give the Front End a minimum amount of basic information regarding a toll scheme. Based on these overview data the Front End may or may not require more information.

EXAMPLE Based on the information in data element `tollContextBoundingBoxes` a Front End dedicated to a passenger car may notice that it is cruising in a toll domain. But due to the information in the data element `operationalStatus` it may realize that this toll regime is currently inactive. In this case the Front End may not require additional data (like context layout or tariff table) of this respective toll scheme.

Structure and data elements of the EFC attribute `TollContextOverview` are given in table below and defined in Annex A.

Table 3 — EFC attribute `TollContextOverview` (informative)

EFC Attribute	Data element	Data Type	Remark
TollContextOverview	tollCharger	TollCharger	
	tollContext	ContextId	
	tollSchemeName	UTF8String	optional
	tollSchemeType	TollSchemeType	
	operationalStatus	OperationalStatus	
	timeZone	INTEGER (-720..720)	
	tollContextBoundingBoxes	SEQUENCE OF SphericalBox	optional
	TollContextOverviewVersion	VersionAndValidity	
	TollContextOverviewAuthenticator	MessageAuthenticator	optional

The data element `tollCharger` shall identify the toll charger which operates the toll scheme for which the context description is valid. The data type shall be `TollCharger` defined in ISO/TS 17575-1:2010.

The data element `tollContext` shall identify the toll context for which the context description is valid. [AC1⟩ The data type shall be `ContextId`, as defined in A.2. ⟨AC1]

The data element `tollSchemeName` shall contain a designation for the toll scheme. The data element shall be optional. The data type shall be UTF8String.

NOTE This data element may be used to display a well known "brand name" of the toll scheme in the OBE (e.g. "LKW Maut", "Go Maut" or "TIS-PL").

The data element `tollSchemeType` shall contain information regarding the type of the toll scheme (road section pricing, distance based area pricing, time based area pricing, cordon pricing).

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The data element `operationalStatus` shall contain information regarding the period of operation of the toll scheme. This information shall be given by defining date and time when the toll regime starts or has started operation (in data element `startsOperationAt`) and optionally by defining date and time when the toll regime will stop operation (in date element `stopsOperationAt`). Both data elements `startsOperationAt` and `stopsOperationAt` shall by of data type `DateAndTime` defined in ISO 14906:2011.

The data element `timeZone` shall give the time zone applicable for the toll scheme in relation to UTC. The data type is `INTEGER(-720..720)`. The value shall be given in minutes in relation to UTC (-720 … +720 minutes). In case one single toll domain is located on more than one time zone, this toll domain shall be split into two separate toll contexts and have two context descriptions.

All absolute time information used in EFC attributes and data elements defined in this part of ISO/TS 17575 (especially in the time class definitions) shall be given in local real time. In case daylight-saving time applies the Front End shall be capable of re-calculating time information according to the applicable legal rules.

The data element `tollContextBoundingBoxes` shall contain a list of spherical rectangles which enclose the geographic area of the toll context. Each list entry shall be of data type `SphericalBox`. The data type `SphericalBox` shall contain the description of a spherical rectangle by defining the edges of the rectangle in latitude and longitude. The date element `SphericalBox` shall contain the data elements `southernLatitude`, `northernLatitude`, `westernLongitude` and `easternLongitude`. The data elements in the data type `SphericalBox` shall be used as follows:

[AC1] – data element `southernLatitude` shall contain the lower (southernmost) latitude value (data type `Latitude`),

– data element `northernLatitude` shall contain the larger (northernmost) latitude value (data type `Latitude`),

– data element `westernLongitude` shall contain the lower (westernmost) longitude value (data type `Longitude`) and

– data element `easternLongitude` shall contain the larger (easternmost) longitude value (data type `Longitude`). [AC1]

The data element `TollContextOverviewVersion` shall contain version and validity information for the EFC attribute `TollContextOverview`. The data type shall be `VersionAndValidity`. For details refer to clause 6.2.

The data element `TollContextOverviewAuthenticator` shall contain a message authenticator valid for the EFC attribute `TollContextOverview`. The data type shall be `MessageAuthenticator` defined in ISO/TS 17575-1:2010. The data element `TollContextOverviewAuthenticator` shall be optional.

8.3.3 Data group “Tariff Information”

8.3.3.1 Concept and overview

The EFC attributes in the data set Tariff Information shall contain all necessary information regarding

– tariff table

– tariff classes and

– locally applicable definitions for vehicle classes, time classes and user classes.

All these information is toll regime specific.

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The data set shall comprise the EFC attributes

- `TariffTable`
- `TariffClassDefinition`
- `LocalVehicleClassDefinition`
- `TimeClassDefinition`
- `UserClassDefinition`

The following clauses give the descriptions and definitions for these EFC attributes.

The fee calculation algorithm is specified in clause 8.3.3.7.

8.3.3.2 Tariff table

Each EFC context description contains exactly one tariff table. The tariff table comprises the following information:

- For each tariff class:
  - a unique tariff class identifier,
  - a basic fee per charge unit,
  - the VAT amount per charge unit,
  - an interval scale parameter (optional),
  - an offset fee (optional)
  - a minimum fee (optional),
  - a threshold fee (optional) and
  - a maximum fee (optional)
- the applicable rounding rule (optional)
- version and validity information
- authenticator (optional).

The tariff table provides all tariff data to the Front End which are required to calculate the Fee which has to be paid by a user under given and defined conditions (vehicle class, time class, …).

8.3.3.2.1 EFC attribute TariffTable

The tariff table shall be presented in the EFC attribute `TariffTable`.

Structure and data elements of the EFC attribute `TariffTable` are given in Table 4 and defined in Annex A.

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Table 4 — EFC attribute `TariffTable` (informative)

EFC Attribute	Data element	Data Type	Remark
TariffTable	tariffs	SEQUENCE OF Tariff	
	roundingRule	RoundingRule	optional
	tariffTableVersion	VersionAndValidity	
	tariffTableAuthenticator	MessageAuthenticator	optional

The data element `tariffs` shall contain a list of tariff related data for each tariff class. Each of the list entries shall be of data type `Tariff`. This data type is described in clause 8.3.3.2.2.

The optional data element `roundingRule` shall contain information regarding rounding of fees. The data type shall be `RoundingRule` which is an `ENUMERATED`. The following values are defined:

– `no` (0) - no rounding is applied,

– `up` (1) - always rounding up to the next larger value of the currencies minor unit,

– `down` (2) - always rounding down to the next lower value of the currencies minor unit,

– `accounting` (3) - always rounding according to methods used in accounting (e.g. defined in DIN 1333).

The data element `tariffTableVersion` shall contain version and validity information for the EFC attribute `TariffTable`. The data type shall be `VersionAndValidity`. For details refer to clause 6.2.

The data element `tariffTableAuthenticator` shall contain a message authenticator valid for the EFC attribute `TariffTableDefinition`. The data type shall be `MessageAuthenticator` defined in ISO/TS 17575-1. The data element `tariffTableAuthenticator` shall be optional.

8.3.3.2.2 Data type Tariff

The data type `Tariff` shall provide the following information per tariff class:

– a tariff class identifier (to unambiguously identify a tariff class within the toll context description),

– the charge unit (e.g. 100 m)

– monetary unit (e.g. EUR)

– basic fee per charge unit (e.g. 0,03 EUR/km),

– optional VAT amount (also given per charge unit),

– optional interval scale parameter,

– optional offset fee,

– optional minimum fee,

– optional threshold fee and

– optional maximum fee.

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Structure and data elements of the data type `Tariff` are given in Table 5 and defined in Annex A.

Table 5 — Data type `Tariff` (informative)

Data type	Data element	Data type	Remark
Tariff	tariffClass	TariffClassId	
	chargeUnit	ChargeUnit	
	currency	Currency	
	basicFeePerChargeUnit	Real	
	vat	Int3	optional
	intervalScaleParameter	IntervalScaleParameter	optional
	offsetFee	Int3	optional
	minFee	Int3	optional
	thresholdFee	Int3	optional
	maxFee	Int3	optional

The data element `tariffClass` shall identify the tariff class. The data type shall be `TariffClassId`. This data type is defined as `Int1`. The applicable tariff class is defined in attribute `TariffClassDefinition`, which is defined in clause 8.3.3.3.

Data element `chargeUnit` shall contain the charge unit valid for the toll regime. It contains the smallest interval of time period, distance or number of events which is of relevance for the fee calculation. A charge unit shall have one of the following natures

– a distance (e.g. 100 m or 1 km) or

– a time period (e.g. 10 min, one hour or 7 hours) or

– a number of event occurred (e.g. one passage).

The use of charge units depend on the type of the charging scheme. The following combinations of charge unit type and toll regime type shall be possible:

– distance (e.g. meter, km) shall only be used in section or area pricing schemes,

– time (e.g. seconds, minutes, hours) shall only be used in area pricing schemes,

– event (number of passages) shall only be used in cordon or section pricing schemes

EXAMPLE 1 A section pricing scheme may use as charge unit 1 km, as the fee depends on the length of the used sections. In this example the fee increases every 1 km.

EXAMPLE 2 An area pricing scheme may use as charge unit 1 hour, as the fee depends on the duration of stay in the defined area. In this example the fee increases every hour.

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EXAMPLE 3 A cordon pricing scheme may use as a charge unit 1 event, as the fee depends on the number of passages of the cordon. In this example the fee increases with every single event.

NOTE 1 In time based pricing schemes the charge unit may also be used to define the smallest possible time periods to be used in the fee calculation.

EXAMPLE 4 A time based pricing scheme with a charge unit value of 7 hours may be defined. In case the basic fee is defined by 5 GBP a stay in the charging area of less than seven hours would in any case result in a Fee of 5 GBP.

The data element `chargeUnit` shall be of data type `ChargeUnit` which is a `CHOICE` type and has the type `distance`, `time` or `event`. The data type of the data element `distance` shall be `Distance` defined in ISO/TS 17575-1. The data type of data element `time` shall be `Duration` which is defined in ISO/TS 17575-1. The data type of the data element `event` shall be `Int1`.

The data element `currency` shall identify the monetary unit applicable for this toll context and used in conjunction with the data elements `basicFeePerChargeUnit`, `vat`, `offsetFee`, `minFee`, and `thresholdFee` and `maxFee`. The data type shall be `Currency`.

The data element `basicFeePerChargeUnit` shall contain the basic fee per charge unit. The data type shall be `REAL`. The value shall be given in major units of the defined currency. The data element `basicFeePerChargeUnit` shall be given excluding VAT.

EXAMPLE 5 A `basicFeePerChargeUnit` value of 0,0175 and `currency` value of “EUR” specifies 0,0175 EUR = 1,75 Cent.

The optional data element `vat` shall contain the VAT per charge unit. The data type shall be `Int3`. The value shall be given in 0,01 %.

The optional data element `intervalScaleParameter` shall contain a list of additional parameters to adapt the basic fee depending on the parameters maximum laden weight of a vehicle and the length of the vehicle. These parameters shall contain offset values (data element `zeroOffset`), resolution data (data element `resolution`) and maximum values (data element `max`).

NOTE 2 Maximum laden weight of vehicles as interval scale parameters are currently in use in the Swiss LSVA toll scheme. The maximum length of a vehicle may be useful e.g. for payment for use of ferries.

The optional data element `offsetFee` shall be use to specify an offset value which should be added to the calculated fee (refer also to chapter 8.3.3.7). The data type shall be `Int3`. The value shall be given in 1/100 of the minor unit of the defined currency.

The optional data element `minFee` shall be use to specify a minimum fee. This minimum fee may be lower than the fee which would apply according to the real usage of the charged network. The data type shall be `Int3`. The value shall be given in 1/100 of the minor unit of the defined currency.

EXAMPLE 6 A minimum fee of e.g. 1,00 EUR may apply in cases where only a short section of an section pricing scheme has been used by a vehicle would lead to a fee of only 0,10 EUR (e.g. 1 km x 0,10 EUR/km = 0,10 EUR).

The optional data element `thresholdFee` shall be used to specify a threshold fee. In case the fee which results from the real usage of the charged network is lower than the threshold value no fee shall apply. The data type shall be `Int3`. The value shall be given in 1/100 of the minor unit of the defined currency.

EXAMPLE 7 A vehicle uses a time based area pricing scheme for 10 minutes. The fee valid for the applicable tariff class is specified by 0,02 EUR per minute. The threshold fee is specified by 0,30 EUR. As the calculated fee does not reach the threshold value the resulting fee is 0,00 EUR.

The optional data element `maxFee` shall contain a maximum value for the fee valid for the particular tariff class. The data type shall be `MaxFee`.

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The data type **`MaxFee`** allows the specification of different maximum fee values

– per day,

– per week,

– per month or

– per year.

The value shall be given in minor units of the defined currency.

NOTE 3 This parameters may be used e.g. in cordon pricing schemes to cap the maximum fee due per day in case of multiple passages of the cordon border.

EXAMPLE 8 A **`maxFee`** value of 11650 and **`currency`** value of “EUR” specifies 116,50 EUR maximum fee.

8.3.3.3 Tariff class definition

Tariff classes are always considered to be toll regime specific. Tariff classes depend on one or more of the following determinants

– vehicle class

– time class

– location class

– user class.

The four tariff determinants can be defined and used completely independent from each other (orthogonal).

Each valid combination of the tariff determinants vehicle class, time class, location class and user class shall lead to one tariff class (Figure 8).

NOTE A “combination” means a logical AND of the four tariff determinants.

Different combinations of the tariff determinants may lead to the same tariff class.

EXAMPLE Both combinations {t1; v4; u34; l21} and {t4; v4;u34; l23} may lead to tariff class 345.

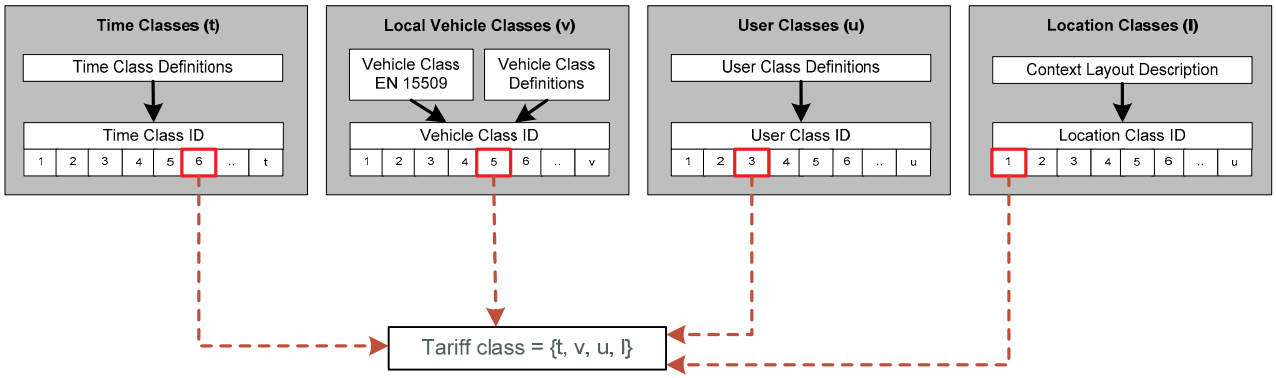

Figure 8 — Principle of creation of tariff classes

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There shall be only one applicable tariff class for a user with one single contract for one single vehicle (with a given and fixed characteristic) as long as the vehicle uses one single charge object (with one single location class) at a specific point in time.

8.3.3.3.1 EFC attribute TariffClassDefinition

Tariff classes shall be defined in the EFC attribute `TariffClassDefinition`.

Structure and data elements of the EFC attribute `TariffClassDefinition` are given in Table 6 and defined in Annex A.

Table 6 — EFC attribute `TariffClassDefinition` (informative)

EFC Attribute	Data element	Data Type	Remark
TariffClassDefinition	tariffClasses	SEQUENCE OF TariffClass	
	tariffClassDefinitionVersion	VersionAndValidity	
	tariffClassDefinitionAuthenticator	MessageAuthenticator	optional

The data element `tariffClasses` shall contain a list of data types `TariffClass`. This data type is described in clause 8.3.3.3.2.

The data element `tariffClassDefinitionVersion` shall contain version and validity information for the EFC attribute `TariffClassDefinition`. The data type shall be `VersionAndValidity`. For details refer to clause 6.2.

The data element `tariffClassDefinitionAuthenticator` shall contain a message authenticator valid for the EFC attribute `TariffClassDefinition`. The data type shall be `MessageAuthenticator` defined in ISO/TS 17575-1. The data element `tariffClassDefinitionAuthenticator` shall be optional.

8.3.3.3.2 Data type TariffClass

The data type `TariffClass` shall contain all valid combinations of the tariff determinants local vehicle class, time class, location class and user class for a tariff class.

Structure and data elements of the data type `TariffClass` are given in Table 7 and defined in Annex A.

Table 7 — Data type `TariffClass` (informative)

Data type	Data element	Data type	Remark
TariffClass	tariffClassId	TariffClassId	
	localVehicleClasses	SEQUENCE OF LocalVehicleClassId	optional
	timeClasses	SEQUENCE OF TimeClassId	optional
	locationClasses	SEQUENCE OF LocationClassId	optional
	userClasses	SEQUENCE OF UserClassId	optional

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Each tariff class shall have a unique identifier (data element `tariffClassId` of data type `TariffClassId`).

The data element `localVehicleClasses` shall contain one or more locally defined vehicle classes. The data type shall be `LocalVehicleClassId`. Vehicle classes shall be defined in EFC attribute `LocalVehicleClassDefinition` (refer to clause 8.3.3.4).

The data element `timeClasses` shall contain one or more time classes. The data type shall be `TimeClassId`. Time classes shall be defined in EFC attribute `TimeClassDefinition` (refer to clause 8.3.3.5).

The data element `locationClasses` shall contain one or more location classes. The data type shall be `LocationClassId`. Location class information shall be part of the context layout description (refer to clause 8.3.4).

The data element `userClasses` shall contain one or more user classes. The data type shall be `UserClassId`. User classes shall be defined in EFC attribute `UserClassDefinition` (refer to chapter 8.3.3.6).

EXAMPLE 1 Tariff Class 56 may be defined as the combination of Local Vehicle Class 23 and User Class 2.

EXAMPLE 2 Tariff Class 106 may be defined as the combination of Local Vehicle Classes 23, 78 and 98 Time Classes 32 and 206.

EXAMPLE 3 Tariff Class 87 may be defined as the User Class 1.

EXAMPLE 4 Tariff Class 202 may be defined as the combination of Local Vehicle Classes 156, 223 and 224 and Time Class 45 and Location Classes 2 and 5 and User Class 2.

8.3.3.4 EFC attribute LocalVehicleClassDefinition

The attribute `LocalVehicleClassDefinition` shall contain all necessary data to define vehicles classes which locally apply in the respective toll regime.

Structure and data elements of the EFC attribute are given in Table 8 and defined in Annex A.

Table 8 — EFC attribute `LocalVehicleClassDefinition` (informative)

EFC Attribute	Data element	Data type	Remark
LocalVehicleClass Definition	localVehicleClasses	SEQUENCE OF LocalVehicleClass	
	localVehicleClassDefinitionVersion	VersionAndValidity	
	localVehicleClassDefinitionAuthenticator	Message Authenticator	optional

The data element `localVehicleClasses` shall contain a list of data types `LocalVehicleClass`. This data type is described in clause 8.3.3.4.1.

The data element `localVehicleClassDefinitionVersion` shall contain version and validity information for the EFC attribute `LocalVehicleClassDefinition`. The data type shall be `VersionAndValidity`. For details refer to clause 6.2.

The data element `localVehicleClassDefinitionAuthenticator` shall contain a message authenticator valid for the EFC attribute `LocalVehicleClassDefinition`. The data type shall be `MessageAuthenticator` defined in ISO/TS 17575-1. The data element `localVehicleClassDefinitionAuthenticator` shall be optional.

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8.3.3.4.1 Data type LocalVehicleClass

The data type `LocalVehicleClass` contains the definition for one vehicle class. Structure and data elements of the data type `LocalVehicleClass` are given in Table 9 and defined in Annex A.

Table 9 — Data type `LocalVehicleClass` (informative)

Data Type	Data element	Data Type	Remark
LocalVehicleClass	localVehicleClassId	LocalVehicleClassId	
	nominalElements	NominalVehicleParameters	
	ordinalElements	OrdinalVehicleParameters	optional
	priorityLevel	Int1	optional

Each local vehicle class shall have an unique identifier (`localVehicleClassId`) of the data type `LocalVehicleClassId`.

EXAMPLE 1 Vehicle class 21 may be defined as all trucks between 3,5 and 12 t <u>and</u> having 3 axles.

EXAMPLE 2 Vehicle class 107 may be defined as passenger cars having 3 or 4 axles <u>and</u> euro classes better than 5.

EXAMPLE 3 To exempt vehicles with very low emissions from charges e.g. in a city charging scheme, these vehicles may be grouped into one vehicle class (e.g. 67) which is defined by all vehicles with euro class 6.

In the context of tariffs vehicle specific parameters may have different nature. Vehicle specific parameters may be used as

– nominal scale parameter or

– ordinal scale parameter

The data elements `nominalElements` and `ordinalElements` (optional) shall contain the description of vehicle parameters for each local vehicle class.

Each locally defined vehicle class may depend on one or more vehicle specific parameters. Vehicle specific parameters are already defined as attributes in ISO 14906 for the purposes of EFC.

NOTE 1 This part of ISO/TS 17575 uses existing data elements (defined in ISO 14906) wherever useful.

NOTE 2 Depending on the toll regime some of the vehicle parameters may be used in a different manner, e.g. as ordinal scale parameter in one toll regime and as nominal scale parameter in a second toll regime.

The data element `nominalElements` shall have the data type `NominalVehicleParameters`. This data type is described in clause 8.3.3.4.2.

The data element `ordinalElements` shall have the data type `OrdinalVehicleParameters`. This data type is described in clause 8.3.3.4.3.

Each vehicle class may contain priority information (`priorityValue`) of data type `Int1`. This data element shall be used to determine which vehicle class is valid in case more than one vehicle class is applicable (e.g. due to overlapping class definitions). A value of 0 shall be used for the lowest priority level, a value of 255 shall be used for the highest priority level.

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