भारतीय मानक
Indian Standard

IS/ISO/TS 17575-4 : 2011

इलैक्ट्रॉनिक शुल्क एकत्रीकरण — स्वायत्त पद्धतियों हेतु अनुप्रयोग की अंतर्प्रष्ठ परिभाषा

भाग 4 रोमिंग

Electronic Fee Collection — Application Interface Definition for Autonomous Systems

Part 4 Roaming

ICS 03.220.20; 35.240.60

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Intelligent Transport Systems Sectional Committee, TED 28

NATIONAL FOREWORD

This Indian Standard (Part 4) which is identical with ISO/TS 17575-4 : 2011 'Electronic fee collection — Application interface definition for autonomous systems — Part 4: Roaming' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Intelligent Transport Systems Sectional Committee and approval of the Transport Engineering Division Council.

This standard is published in four parts. Other parts in this series are:

Part 1 Charging
Part 2 Communication and connection to the lower layers
Part 3 Context data

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions and terminologies are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

The technical committee has reviewed the provisions of the following International Standards/Other Publications referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard/ Other Publication	*Title*
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 14906	Road transport and traffic telematics — Electronic fee collection — Application interface definition for dedicated short-range communication
ISO/TS 17575-2 : 2010	Electronic fee collection — Application interface definition for autonomous systems — Part 2: Communication and connections to the lower layers
ISO/TS 17575-3 : 2011	Electronic fee collection — Application interface definition for autonomous systems — Part 3: Context data
EN 15509 : 2007	Road transport and traffic telematics — Electronic fee collection — Interoperability application profile for DSRC

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Introduction

Autonomous systems

This part of ISO/TS 17575 is part of a series of four 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.

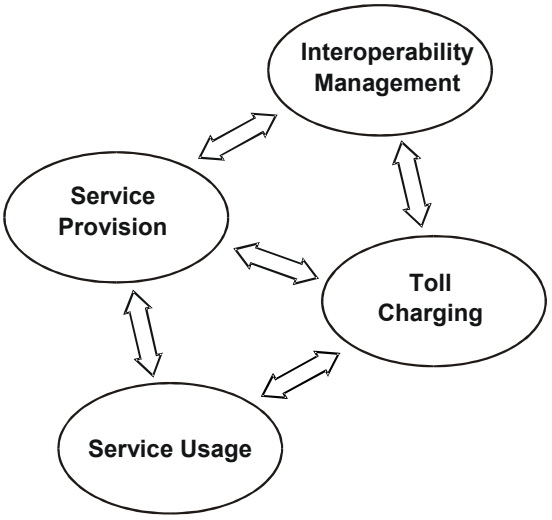

Figure 1 — The rolebased model underlying this Technical Specification

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.

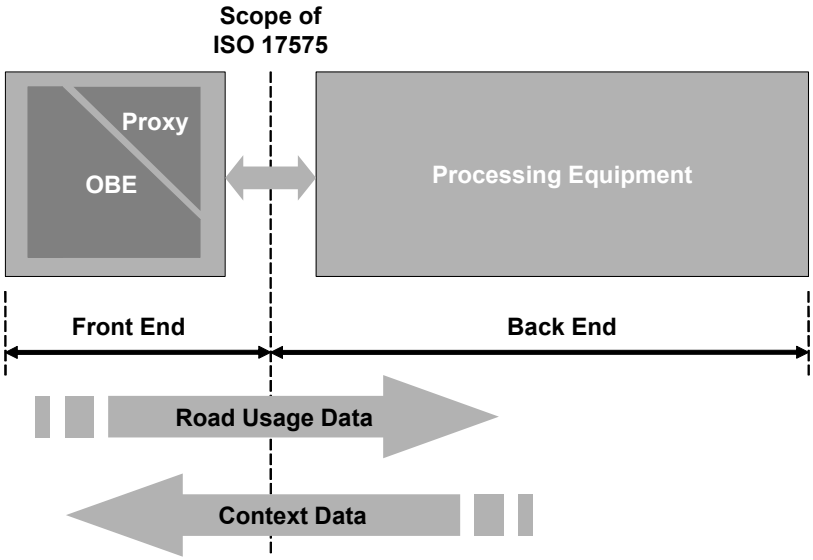

Figure 2 — Assumed technical architecture and interfaces

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.

Relations between single EFC schemes can be

— EFC domains that can adjoin each other so that when moving from one EFC domain in the domain of the adjacent EFC regime there may be a zone where the OBE starts to operate according to the rules of the new regime before stopping the operation according to the old regime rules. Within this zone the OBE/Front-End needs to operate according to the rules for both of these schemes at the same time.

— Overlapping EFC contexts that can have dependencies in the charge object definition like overlapping areas where the outer/bigger area will not be charged when in the inner area. Or an area will not be charged when using a sectioned toll-road in the same area.

— Required to combine several usage statements for different EFC schemes in the same charge report.

The data elements (ADUs) required to specify these related properties are defined in this part of ISO/TS 17575.

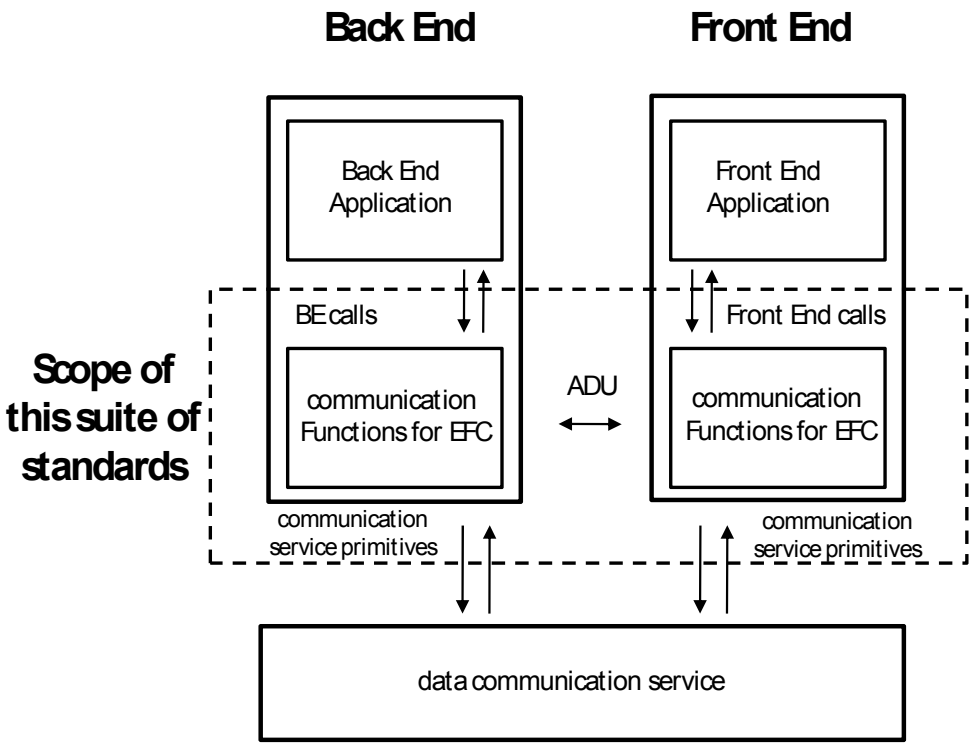

Figure 3 — Scope of ISO/TS 17575

To communicate these ADUs between the Front End and the Back End, the same methodology as for ISO/TS 17575-1 and ISO/TS 17575-3 is applied as illustrated in Figure 3. The use of the communication stack is defined in ISO/TS 17575-2.

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.

Indian Standard

ELECTRONIC FEE COLLECTION — APPLICATION INTERFACE DEFINITION FOR AUTONOMOUS SYSTEMS

PART 4 ROAMING

1 Scope

Roaming in the context of this part of ISO/TS 17575 is understood as the ability of a Front End to operate in more than one EFC context either consecutively or at the same time. Data elements required defining operational properties of a single EFC context are defined in ISO/TS 17575-3. The additional data elements required providing interoperability in overlapping and/or interdependent EFC contexts are defined in this part of ISO/TS 17575.

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*

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

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

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

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

EN 15509:2007, *Road transport and traffic telematics — Electronic fee collection — Interoperability application profile for DSRC*

3 Terms and definitions

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

3.1
associated EFC context
EFC context for which an individual user has the contractual consent that his or her Front End is interoperable

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
contract
expression of an agreement between two or more parties concerning the use of the road infrastructure

[ISO 14906:2011, definition 3.7]

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

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

3.7
interoperability
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

3.8
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]

3.9
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

3.10
roadside equipment
equipment located along the road transport network, for the purpose of communication and data exchanges with on-board equipment

[ISO 14906:2011, definition 3.16]

3.11
service primitive (communication)
elementary communication service provided by the application layer protocol to the application processes

[ISO 14906:2011, definition 3.18]

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

3.12
service provider (toll)
legal entity providing its customers with toll services in one or more toll domains for one or more classes of vehicle

3.13
system
something of interest as a whole or as comprised of parts

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

3.14
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.

3.15
toll charger
legal entity charging toll for vehicles in a toll domain

[ISO/TS 17574:2009, definition 3.27]

3.16
toll cluster
group of toll schemes operating under a common agreement providing interoperability for vehicles equipped with an appropriate OBE and being contracted under a toll service provider being part of the cluster

3.17
toll context
logical view of a toll scheme as defined by attributes and functions

NOTE Adapted from ISO/TS 12813:2009.

3.18
toll domain
area or part of a road network where a toll regime is applied

[ISO 14906:2011, definition 3.21]

3.19
toll regime
set of rules, including enforcement rules, governing the collection of toll in a toll domain

3.20
toll scheme
organizational view of a toll regime, including the group of actors of one toll domain and their relationships

3.21
toll service
service enabling users having only one contract and one set of OBE to use a vehicle in one or more toll domains

NOTE Adapted from ISO/TS 12813:2009.

3.22
toll system
overall view of a toll scheme or toll cluster

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

3.23
transaction
whole of the exchange of information between Front End and Back End necessary for the completion of a toll operation

NOTE Adapted from ISO 14906:2011.

3.24
transaction model
functional model describing the general structure of Electronic Payment Fee Collection transactions

[ISO 14906:2011, definition 3.25]

3.25
user
generic term used for the customer of a toll service provider, one liable for toll, the owner of the vehicle, a fleet operator, a driver, etc., depending on the context

[ISO 14906:2011, definition 3.26]

4 Abbreviated terms

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

ADU Application data unit

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

EFC Electronic Fee Collection (ISO 14906); here used equivalently to the term toll in ISO 17573

NOTE The European Directive 2004/52/EC uses the term toll for the same purpose. However it refers to all kinds of toll declaration means including manual ones. In contrast to this, this part of ISO/TS 17575 defines only electronic means and includes also fees like parking fees.

GNSS Global Navigation Satellite Systems

VAT Value added tax

5 Basic concept

5.1 General

EFC Front Ends require a set of data elements describing the properties of the EFC regime they are operating for. The basic structure of these data elements is defined in ISO/TS 17575-3. This allows configuring the Front End according to the needs of the local Toll Charger. This includes finding or measuring toll relevant objects. This includes also assembling elements to prepare and transmit appropriate charge reports to the Back End. Single context EFC regimes may not require more than a single set of EFC context data and may not need respecting any roaming rules.

NOTE 1 Single EFC context Front Ends may be used without any roaming rules. However, these Front Ends cannot be upgraded handling more than one EFC context without adding the roaming functionality.

In more complex EFC clusters, the full scheme may consist of more than one EFC domain and/or each of these domains may consist of more than one EFC regime and/or an EFC regime may use one or more of the basic tolling principles each of them defined in an individual set of EFC context data.

This structure allows the implementation of an interoperable cluster of EFC regimes keeping the freedom for each of the EFC regimes to define their own set of rules independent of those of others by defining the own regime properties using one or more sets of context data as defined in ISO/TS 17575-3.

Such a composition of an EFC cluster may not be stable over time allowing new EFC regimes or contexts joining this cluster and/or others may terminate their operation.

Front Ends need to adapt their behaviour according to these complex definitions. Front Ends shall apply this concept of using multiple sets of context data complemented by a single set of roaming rules.

The roaming rules as defined in this part of ISO/TS 17575 provide a set of data elements which shall be used by Front Ends when operating within the domain of an EFC cluster consisting of more than one set of EFC context data. This mandatory use includes, if available, also optional data elements as defined in clause 6.2.2.8 and 6.2.3.

NOTE 2 It is most likely that the operation of Front Ends needs to be optimised concerning their computational load by concentrating their operation on EFC domains where vehicles are in or close by. This allows setting the EFC application software for individual known EFC domains to “dormant” and saves with this computing power, memory space and external communication bandwidth. The roaming rules data elements include some optional data elements just for this purpose.

The roaming rule data elements may be originated by each of the Toll Chargers defining therewith their individual needs. Different Toll Chargers operating interdependent EFC schemes are responsible that both their expectations of the overall Front End behaviour are consistent. In the context of this part of ISO/TS 17575 this set of rules is understood as the roaming rules.

Roaming rules may also be part of the EFC context data the Toll Chargers are forwarding to the Toll Service Providers. The Service Providers may eliminate duplications and may concentrate or reconfigure these rules to one single set of roaming rules relevant for Front Ends in the entire interoperable EFC cluster. The structure or format of these overall roaming rules is the same as for complex EFC regimes and is therefore also applicable for the individual Toll Charger.

5.2 Overview

Roaming rules and the associated set of parameters are covering a number of different aspects of interrelations between different EFC schemes. The following scenarios are supported:

a. EFC domains may adjoin each other. Roaming data may be used by a Front-End preparing to operate according to the rules of the adjacent EFC domain. First the liability for paying toll for the current vehicle class and time may be verified. In case the vehicle is liable for paying toll roaming data may be used activating a process ensuring that all the relevant EFC context data are available and the assembling of a new charge report is initialized. A resulting data download depends on the structure and size of the Front End memory and may occur only if an EFC regime is new, is entered the first time or after a long period of time where a previous version of roaming data was used.

   The information required for this scenario are the geographic border of the adjacent EFC domain, its identifier and the minimum vehicle class liable for paying toll.

b. If EFC domains partly or fully overlap then the aspect defined under scenario a. is still relevant. In overlapping domains it may also be required to initialize a secure environment in the Front End to assemble more than one charge report at a time.

   Overlapping EFC regimes may have dependencies in the charge object definition. Examples may be overlapping areas where the outer/bigger area will not be charged when being in the inner area. The

inner area may have an own tariff scheme. Or an area will not be charged when being on a sectioned toll road in the same area which may or may not be charged.

It may also be specified if entering an inner area where the charging of the outer area is halted that the assembled charge report shall be forwarded to the Back End or not. Small inner domains like ferries operated by another Toll Charger may not interrupt the charge report assembling of the outer area. On the other hand if the inner area is an urban region it may be quite likely that the vehicle will stay longer insider so that it makes sense to close the assembling of a charge report for the outer area and forward it to the Back End.

The information required to adapt an Front End to these regulations include a precedence level for each of the participating EFC context indicating that only one or more EFC contexts set to the highest precedence will apply the charge. Another parameter indicate that an EFC account shall be closed and a charge report forwarded if an EFC domain is entered having a higher precedence level.

c. The overall tariff scheme of more complex EFC regimes may be defined using more than one overlapping or non-overlapping basic EFC context. This may be an overall area like a country. Another area may cover an urban region. A third area may be the downtown area of a city and over all of that there may be a sectioned toll road network with a different tariff scheme. This all together may be operated by a single Toll Charger.

   This Toll Charger may require receiving a consolidated charge report including all his contexts. This may also be used addressing the user with a single bill paying for the use of an entire region or country.

   Note: this may be used not to bother the User with details on how the regime is split into different contexts.

   The information required to configure the charge report accordingly is a list of EFC contexts which shall be consolidated and addressing a single Toll Charger.

d. A higher privacy regulation may require that in a more complex EFC regime consisting of several non- or partly overlapping domains the presence of the vehicle shall not be disclosed in charge reports. This may be done by aggregating and hiding all the charge objects but disclosing the regime identifier.

   In such cases it may also be required hiding the fact that a vehicle was present in a certain domain. In this case an aggregated fee may cover more than one EFC regime. However this needs to be operated by the same Toll Charger so that the fee recipient is the same.

6 Data elements

6.1 General

The data set “roaming” consists of a single attribute named **RoamingRules**. For a Front End operating according to the conditions of a specific User a single data set **RoamingRules** is required. This applies independently of the complexity of the interoperable EFC cluster the Front End is operating for.

Without presumption of any implementation it is anticipated that the data elements of the roaming rules are used in a Front End ensuring:

— that each relevant EFC context is recognised as such and charging reports are assembled when the vehicle is moving inside the domain

— that for each of the relevant EFC contexts the associated EFC context data set is available in the Front End. This shall be ensured at least when the vehicle is inside or in a fringe closely outside of the EFC domain

— that the information required handling interdependencies between EFC contexts regarding tariff exclusivenesses are respected in the process evaluating the tariff due.

The information required to do so are the information provided by the **RoamingRules** attribute.

NOTE In contrast to the roaming rules all data elements required by Front End evaluating a single EFC context are provided by the EFC context data attributes defined in ISO/TS 17575-3.

6.2 Elements of the roaming rules attribute

6.2.1 The roaming rule identifier

Within a Back End several roaming rules data sets will be originated and maintained. This is due to version management and maybe caused if more than one option of combinations of interoperable EFC contexts for different Users exists. In order to identify an individual set of roaming rules the identifier **efcRoamingRulesId** shall be used. It is of the type Int2 and shall be unique within the domain of the Back End.

6.2.2 The list of relevant EFC contexts

6.2.2.1 General

An important information of the roaming attribute is the list of relevant EFC contexts defining the composition of the EFC cluster where the Front End shall operate providing interoperability. This list may change over time if the User has been registered for more or less of the existing EFC contexts, if new EFC regimes came up or if other EFC regimes had or will terminate its operation. The information a Front End requires to do so is provided with the **relevantEfcContexts** data element as a list of **RelevantEfcContext**. All existing EFC contexts which are not listed in the **relevantEfcContexts** data element the Front End does not know and therefore will be ignored.

NOTE It is seen to be outside the scope of this part of ISO/TS 17575 to provide means ensuring that proxies operating for more than one OBE apply the correct version of roaming rules. This is especially important if Service Providers offer the interoperability in different combinations of EFC contexts.

6.2.2.2 Sub elements of the RelevantEfcContext element

The data element **RelevantEfcContext** contains the sub data elements Front Ends need to manage the data download of attributes of the context data from the Back End and to organize the internal operation.

6.2.2.3 The efcContextId sub element

The **efcContextId** shall be used to identify the EFC context. This identifier shall correspond with the identifier used in the EFC context data as defined in ISO/TS 17575-3.

6.2.2.4 The reuseTariffInformationFrom sub element

As described above a Front End should optimise its external communication effort. Supporting this the **RelevantEfcContext** data contains elements allowing to indicate that another EFC context applies identical tariffs and that downloading a copy of the tariff information attribute is redundant.

In cases where different EFC contexts are using the same definition of tariff information it is more effective just forwarding and storing this data attribute once. Then for another EFC context it may just be referenced to it indicating that it shall be reused.

A Front End may use the list **reuseTariffInformationFrom** to organize this.

6.2.2.5 The reuseReportingRulesFrom sub element

As described in 6.2.2 also the reporting rules may be same in different EFC contexts. Then the **reuseReportingRulesFrom** list may be used avoiding downloading and storing multiple instances of identical reporting rules as defined in ISO/TS 17575-3.

6.2.2.6 The efcDomainFrame sub element

The **efcDomainFrame** element contains a **BoundingPolygon** which describes the outer fringe of an EFC context. It depends on the requirements of the Front End what distance and resolution this bounding polygon may have relative to the real EFC domain border. The distance assuming a certain vehicle speed shall allow preparing for the adoption of the Front End behaviour according to this next EFC domain before its actual border may be reached.

The **BoundingPolygon** itself is just a list of points consisting of a **Latitude** and a **Longitude**. It is implicit assumed that the border is represented by a line connecting all these points in the order they are listed. The last point shall be connected with the first one.

It is required that the Front End of a vehicle being inside the **efcDomainFrame** activate preparing to participate according to the local EFC regime rules. This must be completed when the vehicle reaches the actual EFC domain border as defined in ISO/TS 17575-3.

6.2.2.7 The liableVehicleClasses sub element

NOTE 1 The term “liable vehicle class” should be read as a vehicle class causing the driver being liable paying toll if he's using a vehicle belonging to it.

This sub element indicates a list of vehicle groups as defined within the attribute VehicleClass in EN 15509. In case the precise definition of the liable vehicle classes cannot be expressed with this vehicle groups one or more comprehensive groups shall be used including all real liable classes. The EFC context data defined in ISO/TS 17575-3 contain a more detailed vehicle class definition which will be applied by the Front End when declaring a toll road usage.

NOTE 2 This may result in indicating a certain vehicle as “liable” for tolling in the roaming data set and “not liable” in the EFC context data. The definition of the EFC context data finally will be applied.

6.2.2.8 The precedenceLevel sub element

In case two or more overlapping EFC domains are depending on each other regarding the declaration of toll relevant events, the individual **precedenceLevel** of all of these domains may be used to manage that. Independent of its implementation a declared toll object in an EFC domain of a higher precedence level shall prevent the toll object declaration of the same kind or amount within an overlapping EFC domain with a lower precedence level.

If both precedence levels are same, then both toll objects shall be declared or forwarded.

Note: An example for this may be an area tolling context which is crossed by an arterial road which is defined as being “out of the area” and may have a different tariff scheme, including a zero price. This can be modelled defining first an EFC context for the area (covering the sectioned toll road) and a second EFC context for the sectioned toll road separately. If the sectioned toll road context has a higher precedence level then the process assembling the usage statement for the area context must ignore the distance of the sectioned toll road or - if it is a time based scheme - ignore the presence in the area for the time being at the sectioned toll road.

6.2.2.9 The sendChargeReportIfEntering sub element

Note: the term “close account” should be understood as terminating the assembling of usage data for a certain EFC context. This will result in forwarding the assembled usage data in a charge report to the Back End.

This sub element may be applied in overlapping EFC domains where the probability of staying longer inside the domain with a higher precedence level is quite high.

Here it can be defined that the charge report assembled for the former used EFC context shall be closed when entering one of the domains listed in **sendChargeReportIfEntering** with a higher precedence level.

NOTE An example for that may be a country wide area toll which will be paid to the state authority and an overlapping urban regional area toll which may be paid to the regional authority. When entering the regional area it may be intended to close the country toll account and forward it to the state authority in the moment the regional area is entered.

6.2.3 The list of EFC contexts which are grouped using a single charge report

The data element **combinedChargeReportContexts** provides a list of one or more **CombinedChargeReportContext**. When listed a single charge report shall be provided to a single **tollRecipient** covering the usage statements of these EFC contexts. These are still listed in **relevantEfcContexts** and further in the appropriate EFC context identified by the **efcContextId** element.

In order to identify different clusters the element **reportingClusterId** is provided. It shall be unique within the entire EFC cluster the Back End is managing.

Because the Charge reports generated for different EFC contexts will be forwarded to a single recipient the **tollRecipient** data element shall be used identifying it.

6.2.4 House keeping data elements

Each roaming rule data set contains a **roamingRuleVersion** in the format of **VersionAndValidity** and an **authenticator** in the format of **MessageAuthenticator** both as defined in ISO/TS 17575-3.

Table 1 — Major Data Elements

Attribute/Element	Scenario	Remark
efcRoamingRulesId	General	Data type Int2
roamingRulesVersion		date and time when validity period of this set of roaming data starts
authenticator		authenticator of the full set of roaming data attribute signed by the originator of the content
relevantEfcContexts	EFC contexts relevant for the Front End	List of adjoining EFC domains
RelevantEfcContext		list
efcContextId		entity identifier according to ISO 14906
reuseTariffInformationFrom		
reuseReportingInformationFrom		
efcDomainFrame		bounding polygon
liableVehicleClasses		list of toll liable vehicle class groups according to EN 15509
precedenceLevel		Identifier of priority if all, some or a single context is charged
sendChargeReportIfEntering		list of EFC contexts when entered triggering a charge event of the former context
combinedChargeReportContexts	multi EFC context schemes using a common charge report	List of overlapping EFC contexts requiring a common charge report
CombinedChargeReportContext		list
reportingClusterId		entity identifier according to ISO 14906
tollRecipient		entity identifier according to ISO 14906
involvedEfcContexts		list of entity identifiers according to ISO 14906

7 Communicating the roaming rules attribute

7.1 Requesting an update of the roaming rules attribute

In response of any charge report forwarded by the Front End to the Back End the Back End may include a **VersionID** as defined in ISO/TS 17575-1. This data element indicates the availability of a new version which shall be used according to the validity period included in this new version.

The Front End shall take this information requesting an update of the roaming rules attribute. The request forwarded to the Back End shall be according to ISO/TS 17575-2.

In response to this request the Back End will verify the applicability of the requested roaming rule attribute version for this Front End and may respond forwarding the new version.

7.2 Responding to a roaming rules download request

In the view of this part of ISO/TS 17575, the roaming rules attribute constitute the ADU body as defined in 7.1 of ISO/TS 17575-3:2011.

To communicate the ADU body it must be completed adding the ADU header as defined in 7.2 of ISO/TS 17575-3:2011. Forwarding this ADU shall be according to ISO/TS 17575-2.

7.3 ASN1 coding rules

The EFC data types and associated coding related to the data elements described in Clause 6 are defined using the Abstract Syntax Notation One (ASN.1) technique according to ISO/IEC 8824-1. The packed encoding rules according to ISO/IEC 8825-2 shall be applied.

Annex A
(normative)
EFC data type specifications

Data elements defined in lower levels are part of data elements in higher levels, e.g. the data elements of level 3 are part of the data elements in level 1 or 2. This hierarchy of data elements is shown in Figure A.1.

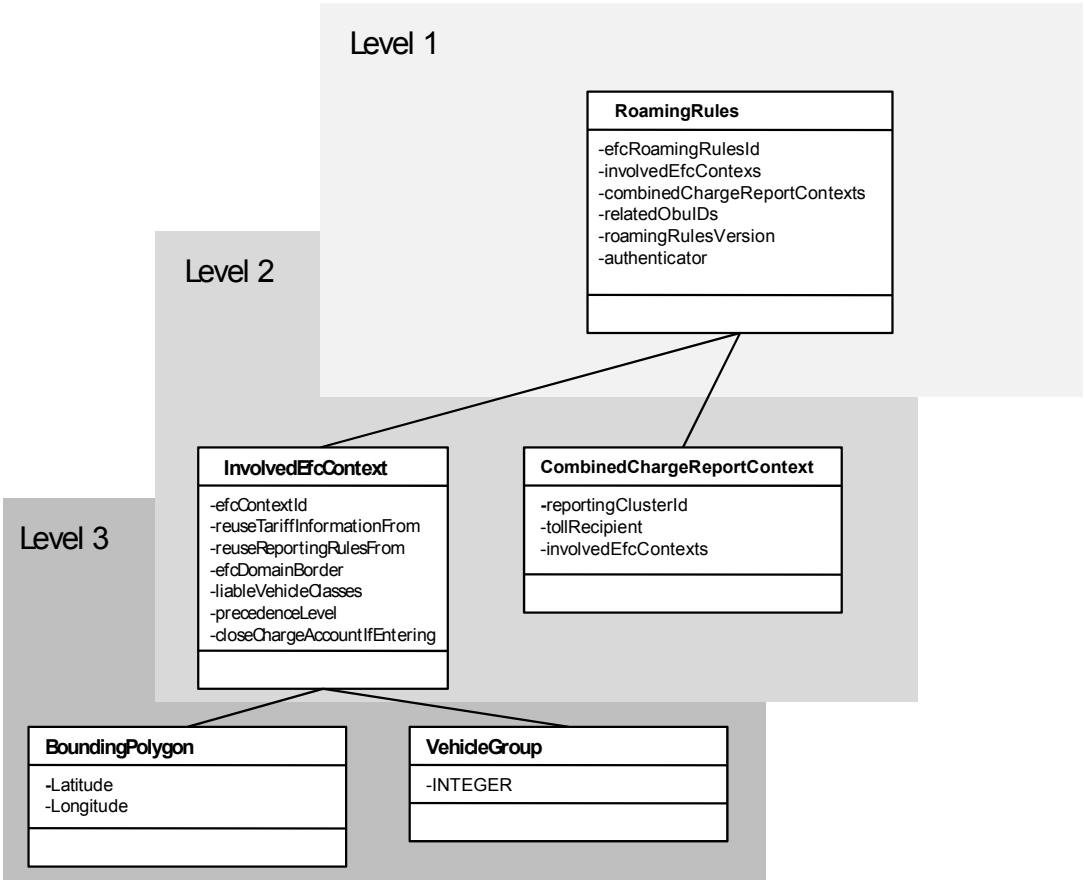

Figure A.1 — Hierarchy of data elements (informative)

```
RoamingModule {iso standard 175754 modules(0) efc(0) version(1)}

DEFINITIONS AUTOMATIC TAGS
::= BEGIN

IMPORTS
VehicleClass, Provider
FROM EfcModule {iso standard 14906 modules(0) efc(0) version(1)}

MessageAuthenticator, EquipmentOBUId, Duration, Distance, VersionID
FROM ChargingModule {iso standard 17575 modules(0) efc(0) version(1)}

VersionAndValidity
FROM ContextDataModule {iso standard 175753 modules(0) efc(0) version(1)}

Longitude, Latitude
FROM CccModule {iso standard 12813 modules(0) ccc(0) version(1)};

-----------------------------------------------
-- Level 1
-----------------------------------------------

RoamingRules ::=                  SEQUENCE {
    efcRoamingRulesId                 INT2,
    relevantEfcContexs                SEQUENCE OF RelevantEfcContext,
    combinedChargeReportContexts      SEQUENCE OF CombinedChargeReportContext OPTIONAL,
    roamingRulesVersion               VersionAndValidity,
    authenticator                     MessageAuthenticator
    }

-----------------------------------------------
-- Level 2
-----------------------------------------------

RelevantEfcContext ::=            SEQUENCE {
    efcContextId                      EntityId,
    reuseTariffInformationFrom        EntityId OPTIONAL,        -- efcContextId
    reuseReportingRulesFrom           EntityId OPTIONAL,        -- efcContextId
    efcDomainFrame                BoundingPolygon OPTIONAL,         -- activate processing
if inside
    liableVehicleClasses              SEQUENCE OF VehicleGroup,
    precedenceLevel                   INT1 OPTIONAL,
    sendChargeReportIfEntering        SEQUENCE OF EntityId OPTIONAL
    }

CombinedChargeReportContext ::=   SEQUENCE {
    reportingClusterId                EntityId,
    tollRecipient                     EntityId,
    involvedEfcContexts               SEQUENCE OF EntityId
    }

-----------------------------------------------
-- Level 3
-----------------------------------------------

BoundingPolygon ::=           SEQUENCE {     -- edges are defined between two
consecutively listed vertices, last edge is between last vertex and first one, the are is
at the right side of the line from a vertex to the next listed one
    latitude                      Latitude,
    longitude                     Longitude
    }

VehicleGroup ::=              INT1       -- vehicle group as defined in EN 15509:2007,
Annex A, Table A2

EntityId ::=                  Provider

INT1 ::= INTEGER(0..255)
INT2 ::= INTEGER(0..65535)

END
```

Annex B
(normative)
PICS proforma

B.1 General

This clause contains the Protocol Implementation Conformance Statements (PICS) proforma to be used for Front End implementation of the charge report protocol defined in clause 6 and Annex A

B.2 General

To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented. Such a statement is called an Implementation Conformance Statement (ICS) or more specific in case it covers transactions a Protocol Implementation Conformance Statements (PICS). This annex provides PICS templates, to be filled in by equipment suppliers.

B.3 Purpose and structure

The purpose of this PICS proforma is to provide a mechanism whereby a supplier of an implementation of the requirements defined in this part of ISO/TS 17575 may provide information about the implementation in a standardized manner.

The PICS proforma is subdivided into clauses for the following categories of information:

- identification of the implementation;
- identification of the protocol;
- global statement of conformance;
- PICS proforma tables.

B.4 Instruction for completing the PICS Proforma

B.4.1 Definition of support

A capability is said to be supported if the Implementation Under Test (IUT) is able:

- to generate the corresponding operation parameters (either automatically or because the end user requires that capability explicitly);
- to interpret, handle and when required make available to the end user the corresponding error or result.

A protocol element is said to be supported for a sending implementation if it is able to generate it under some circumstances (either automatically or because the end user requires relevant services explicitly).

A protocol element is said to be supported for a receiving implementation if it is correctly interpreted and handled and also, when appropriate, made available to the end user.

B.4.2 Status column

This column indicates the level of support required for conformance to the ISO/IEC standard. The values are as follows:

m mandatory support is required;

o optional support is permitted for conformance to the standard. If implemented it must conform to the specifications and restrictions contained in the standard. These restrictions may affect the optionality of other items;

c the item is conditional (support of the capability is subject to a predicate);

c: m the item is mandatory if the predicate is true, optional otherwise;

- the item is not applicable;

i the item is outside the scope of this PICS.

In the PICS proforma tables, every leading item marked 'm' shall be supported by the IUT. Sub-items marked 'm' shall be supported if the corresponding leading item is supported by the IUT.

B.4.3 Support column

This column shall be completed by the supplier or implementor to indicate the level of implementation of each item. The proforma has designed such that values required are:

Y yes, the item has been implemented;

N no, the item has not been implemented;

- the item is not applicable;

All entries within the PICS proforma shall be made in ink. Alterations to such entries shall be made by crossing out, not erasing nor making the original entry illegible, and writing the new entry alongside. All such alterations to records shall be initialized by the staff making them.

B.4.4 Item reference numbers

Each line within the PICS proforma which requires implementation details to be entered is number at the left hand edge of the line. This numbering is included as a mean of uniquely identifying all possible implementation details within the PICS proforma. This referencing is used both inside the PICS proforma, and for references from other test specification documents.

The means of referencing individual responses is done by the following sequence:

— a reference to the smallest enclosing the relevant item;

— a solidus character, '/';

— the reference number of the row in which the response appears;

— if, and only if, more than one response occurs in the row identified by the reference number, then each possible entry is implicitly labeled a, b, c, etc. from left to right, and this letter is appended to the sequence.

B.5 PICS proforma for the Front End

B.5.1 Identification of the implementation

B.5.1.1 Identification of PICS

Item No.	Question	Response
1	Date of Statement (DD/MM/YY)	
2	PICS Serial Number	
3	System Conformance Statement Cross Reference	

B.5.1.2 Identification of the implementation and/or system

Item No.	Question	Response
1	Service provider or EFC context name	
2	Version number	
3	Other information	

B.5.1.3 Identification of the Front End supplier

Item No.	Question	Response
1	Organization Name	
2	Contact Name(s)	
3	Address	
4	Telephone Number	
5	e-mail address	
6	Other information	

B.5.1.4 Identification of the Front End

Item No.	Question	Response
1	Brand Name	
2	Type, Version	
3	Manufacturer ID	
4	Equipment Class	
5	Serial Numbers of supplied units	
6	Other information	

B.5.2 Identification of the standard

Item No.	Question	Response
1	Title, Reference No, publication date of the Technical Specification	
2	TS version Number	
3	Implemented Addenda	
4	Implementor's Guide Version No	
5	Implementation Defect Reports (Ref. No)	
6	Other information	

B.5.3 Global statement of conformance

Are all mandatory capabilities implemented? (Yes/No) ……

NOTE 1 Answering "No" to this question indicates non-conformance to the specification. Non-supported mandatory capabilities are to be identified in the ICS, with an explanation of why the implementation is non-conforming, on pages attached to the ICS proforma.

Which security level is implemented (0/1) ……

NOTE 2 See 5.1.5 and Annex D for definition of the of security levels.

B.5.4 PICS proforma tables

This part of the PICS proforma identifies the supported application context, the communication services and attributes (ADUs).

Table B.1 — Security requirements

Item No.	Element	Reference	Status	Support
1	roamingRulesVersion	ISO/TS 17575-3	m	
2	authenticator	ISO/TS 17575-3	m	

Table B.2 — Communication channel access

Item No.	Element	Reference	Status	Support
1	requesting update when recognising the event requiring new roaming data	7.1	m	
2	Initialization of the communication channel	7.1 and ISO/TS 17575-2	m	
3	StartSession	ISO/TS 17575-2		
4	GetParameter	ISO/TS 17575-2	m	
5	receiving structured Messages	ISO/TS	m	

Item No.	Element	Reference	Status	Support
		17575-2		
6	interpreting ADU header	ISO/TS 17575-2	m	
7	Session Failure	ISO/TS 17575-2	m	
8	EndSession	ISO/TS 17575-2	m	

Table B.3 — Implemented communication services

Item No.	Element	Reference	Status	Support
1	ISO/TS 17575-2 access	ISO/TS 17575-2	m	
2	other			

Table B.4 — Level 1 data elements supported

Item No.	Element	Reference	Status	Support authentication	Support coding
1	efcRoamingRulesId	6.2	m		
2	relevantEfcContexts	6.2	m		
3	combinedChargeReportContexts	6.2	o		

Table B.5 — Level 2 data elements supported

Item No.	Element	Reference	Status	Support authentication	Support coding
1	efcContextId	6.2	m		
2	reuseTariffInformationFrom	6.2	o		
3	reuseReportingRulesFrom	6.2	o		
4	efcDomainFrame	6.2	o		
5	liableVehicleClasses	EN 15509:2007, Annex A, Table A2	m		
6	precedenceLevel	6.2	o		
7	sendChargeReportIfEntering	6.2	o		
8	reportingClusterId	6.2	m		
9	tollRecipient	6.2	m		
10	involvedEfcContexts	6.2	m		

The following table can be used to provide any other relevant information:

NOTE Here to add information regarding the Front End which are relevant for testing but not covered in the items above. This may include additional features like other communication media or other proprietary attributes for local use.

Table B.6 — Other information

Item No.	Other Information

B.6 PICS proforma for the Back End

B.6.1 Identification of the implementation

B.6.1.1 Identification of PICS

Item No.	Question	Response
1	Date of Statement (DD/MM/YY)	
2	PICS Serial Number	
3	System Conformance Statement Cross Reference	

B.6.1.2 Identification of the implementation and/or system

Item No.	Question	Response
1	Service provider or EFC context name	
2	Version number	
3	Other information	

B.6.1.3 Identification of the Back End supplier

Item No.	Question	Response
1	Organization Name	
2	Contact Name(s)	
3	Address	
4	Telephone Number	
5	e-mail address	
6	Other information	

B.6.1.4 Identification of the Back End

Item No.	Question	Response
1	Brand Name	
2	Type, Version	
3	Manufacturer ID	
4	Serial Numbers of supplied units	
5	Other information	

B.6.2 Identification of the standard

Item No.	Question	Response
1	Title, Reference No, publication date of the Technical Specification	
2	TS version Number	
3	Implemented Addenda	
4	Implementor's Guide Version No	
5	Implementation Defect Reports (Ref. No)	
6	Other information	

B.6.3 Global statement of conformance

Are all mandatory capabilities implemented? (Yes/No) ……

NOTE 1 Answering "No" to this question indicates non-conformance to the specification. Non-supported mandatory capabilities are to be identified in the ICS, with an explanation of why the implementation is non-conforming, on pages attached to the ICS proforma.

Which security level is implemented (0/1) ……

NOTE 2 See 5.1.5 and Annex D for definition of the of security levels.

B.6.4 PICS proforma tables

This part of the PICS proforma identifies the supported application context, the communication services and attributes (ADUs).

Table B.7 — Security requirements

Item No.	Element	Reference	Status	Support
1	roamingRulesVersion	ISO/TS 17575-3	m	
2	authenticator	ISO/TS 17575-3	m	

Table B.8 — Communication channel access

Item No.	Element	Reference	Status	Support
1	recognising roaming rules address using the attributeID	7.1	m	
2	sending structured Messages	7.2 and ISO/TS 17575-2	m	

Table B.9 — Implemented communication services

Item No.	Element	Reference	Status	Support
1	ISO/TS 17575-2 access	ISO/TS 17575-2	m	
2	other			

Table B.10 — Level 1 data elements supported

Item No.	Element	Reference	Status	Support authentication	Support coding
1	efcRoamingRulesId	6.2	m		
2	relevantEfcContexts	6.2	m		
3	combinedChargeReportContexts	6.2	o		

Table B.11 — Level 2 data elements supported

Item No.	Element	Reference	Status	Support authentication	Support coding
1	efcContextId	6.2	m		
2	reuseTariffInformationFrom	6.2	o		
3	reuseReportingRulesFrom	6.2	o		
4	efcDomainFrame	6.2	o		

Item No.	Element	Reference	Status	Support authentication	Support coding
5	liableVehicleClasses	EN 15509:2007, Annex A, Table A2	m		
6	precedenceLevel	6.2	o		
7	sendChargeReportIfEntering	6.2	o		
8	reportingClusterId	6.2	m		
9	tollRecipient	6.2	m		
10	involvedEfcContexts	6.2	m		

The following table can be used to provide any other relevant information:

NOTE Here to add information regarding the Back End which are relevant for testing but not covered in the items above. This may include additional features like other communication media or other proprietary attributes for local use.

Table B.12 — Other information

Item No.	Other Information

Annex C
(informative)
How to assemble and use roaming data

C.1 General

The following guidelines illustrate how EFC roaming data may be used supporting the adoption of Front Ends to specific local rules. The originator of these roaming data is in the view of this part of ISO/TS 17575 the Back End. However, if the roles of the Back End are split among different organizations like Toll Service Provider and Toll Charger then the originator of the roaming rule is the actor responsible for the Front End. This may be the Service Provider.

Even if this infringes the generalised view of this part of ISO/TS 17575 for better understandability in the following clauses the actor originating the roaming data will be named the Service Provider even if in some cases that may be organized differently.

The Service Provider has to take information about local rules for EFC contexts defined by all of the Toll Chargers in which the Front End shall be interoperable and combine them with own conditions which may result from specific contractual arrangements with its customers. It may be the case that a single Service Provider may define different sets of roaming data for different categories of Front Ends. This is the case if different contractual conditions with the users allow interoperability with a different subset of all existing EFC regimes. This may also be the case if the specific vehicle of a user is liable paying toll only in a subset of the EFC regimes the Service Provider in general is interoperable with. And other vehicles are liable in different subsets of all the EFC regimes. However for each Front End one and only one roaming data set is required.

In order to reduce complexity some of the options available in this part of ISO/TS 17575 are not mentioned here if their use is not of a high importance for the general understanding. So, for the use in real operational life, the normative part of this part of ISO/TS 17575 shall be used instead.

C.2 Step 1

The first step in the roaming data definition is answering the question how many different roaming data sets shall be defined and maintained.

NOTE In all cases for a single Front End operating for a specific vehicle one and only one roaming data set is required in all cases.

In cases where there are no subsets of interoperable EFC regimes offered one single roaming data set may be sufficient. All Front Ends are using the same roaming data set. This is logically correct, however, it might be more effective if, for instance, passenger cars may use roaming data in which the EFC regimes relevant just for trucks may not been mentioned.

On the other hand, a full set of roaming rules may be used to indicate to the driver that in a certain EFC regime his specific vehicle is not liable to pay toll. It is up to the policy of the Service Provider how to handle that.

In cases where it was left to the user which subsets of EFC regimes should be included in the interoperable scheme it is required to use partly different roaming rules with a different list of participating EFC regimes.

If the Service Provider decides (maybe due to requirements of the Toll Chargers) that different vehicle categories may send charge reports according to different events then different roaming rules need to be used because in these roaming data a different reference to context data should be used. Then, in the context data different reporting rules may be listed.

Another argument for using different roaming rules for different customers, users or vehicle categories may be different requirements on privacy issues. Here trucks may have different requirements on the details of usage

statements than private cars. This can be achieved using different roaming data referencing to different instances of context data.

A last extreme example is for very specific hazardous good transporters where specific rules shall be applied in the different EFC regimes within the interoperable domain. Therefore very specific context data are required and a special instance of roaming data may reference on them.

C.3 Step 2

The second step is to start assembling in each of the specific instances of a roaming data set the relevant EFC contexts. EFC contexts may include adjacent EFC domains with a partly common or overlapping border or just the list of EFC contexts where interoperability is achieved. This includes the contexts of contracted Toll Charger partners where users have been registered for.

EFC contexts may also list EFC regimes which are defined using more than one set of EFC context data. These EFC clusters may be more complex schemes which could not be assigned to one singe basic tolling principle. Such schemes may use any combination of these basic tolling principles which may result in very complex structures. It is up to the Toll Charger reducing the complexity of his scheme to something which is understandable by the users. However the Front Ends should be able handling a certain number of EFC contexts at the same time.

NOTE It is scope of a profile standard or a bilateral agreement how many EFC contexts a Front End may handle in parallel. This should include adjacent contexts if they all need to be active in the Front End for instance if the vehicle is about to move from one domain into another.

EFC regimes using combined contexts may consist of one or more instances of area pricing contexts, which may or may not include one or more networks which will be charged according to different tariffs. An example for that can be a country wide area pricing context where another overlaying area context may cover an urban region. Another overlaying context may be the inner city and on top of it a parking area in the inner city. These contexts may be charged according to travelled distance or stayed time

It may also include one or more inner cordon pricing contexts and/or an overlapping sectioned road context. It is up to the Toll Charger defining that. There is no limit according to this part of ISO/TS 17575; however it must be agreed between all stakeholders on a maximum number of parallel operated contexts.

For each of the contexts a set of other data may be defined. This is the outside fringe of the context border, if the tariff information and/or reporting rules can be reused from other contexts, which of the vehicle groups are liable paying toll, which of overlapping context shall be paid and others.

C.4 Step 3

The next definition in the roaming rules is which EFC contexts shall combine its charge report into a single one and report it as if this group of contexts is a single EFC regime. This may be applied in EFC schemes consisting of several EFC contexts to reduce its complexity during billing to the Service Provider, the Toll Charger and the User. It consists of one or more lists of EFC contexts which should be interpreted so that all contexts in each list shall combine their usage statements into a single charge report. And for each of these the Toll Charger as the recipient of the toll should be identified.

C.5 Step 4

The last step is required only for Front Ends making use of a proxy. Here the proxy needs to download and store all the different instances of roaming rules which should be applied for different categories of customers. To allow assigning the correct roaming rule data set to each of the OBE it is required that the proxy has access to a list of OBE IDs and their correct roaming rule set.

This completes the steps assembling one or more instances of roaming rule data sets to be accomplished by each of the entities responsible for one or more Front Ends which most likely will be the Service Providers.

Bibliography

[1] ISO/IEC 9646-7, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 7: Implementation Conformance Statements*

[2] ISO 12813, *Electronic fee collection — Compliance check communication for autonomous systems*

[3] ISO 17573, *Electronic fee collection — Systems architecture for vehicle-related tolling*

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