INTERNATIONAL STANDARD

ISO 17575-1

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Electronic fee collection — Application interface definition for autonomous systems —

Part 1: Charging

Perception du télépéage — Définition de l'interface d'application pour les systèmes autonomes —

Partie 1: Imputation

Reference number
ISO 17575-1:2016(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

This edition of ISO 17575-1 cancels and replaces ISO/TS 17575-1:2010, which has been technically revised. The following changes have been made:

— conversion from a Technical Specification to an International Standard;

— amendments to reflect changes to the underlying base standards, especially ISO 14906;

— adoption of security prescriptions previously located in other standards for specification of authenticated data structures;

— editorial and formal corrections as well as changes to improve readability.

ISO 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*

In this edition of the ISO 17575-series the contents of ISO/TS 17575-4:2011 were incorporated into ISO 17575-3:2016. ISO/TS 17575-4:2011 will be withdrawn once ISO 17575-3 has been published.

Introduction

0.1 Autonomous systems

ISO 17575 is a series of standards 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 Networks (CN). These EFC systems are referred to by a variety of names. In addition to the terms autonomous systems and GNSS/CN systems, the terms GPS/GSM systems and wide-area charging systems are also 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.

Two 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 17575.

0.2 The parts of ISO 17575

Part 1: Charging, defines the attributes for the transfer of usage data from the Front End to the Back End. The contents of charge reports might vary between toll regimes, 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. A toll regime comprises a set of rules for charging, including the charged network, the charging principles, the liable vehicles and a definition of the required contents of the charge report.

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. The data defined in this part of ISO 17575-1 and ISO 17575-3 can but need not be exchanged using the communication stack as defined in ISO 17575-2.

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 ISO 17575-3 are used to transfer data to the Front End in order to instruct it on which data to collect and report.

0.3 Application needs covered by ISO 17575

The ISO 17575-series of standards

— is compliant with the architecture defined in ISO 17573:2010,

— supports charges for use of road sections (including bridges, tunnels, passes, etc.), passage of cordons (entry/exit) and use of infrastructure within an area (depending on distance, time),

— supports fee collection based on units of distance or duration, and based on occurrence of events,

— supports modulation of fees by vehicle category, road category, time of usage and contract type (e.g. exempt vehicles, special tariff vehicles, etc.),

— supports limiting of fees by a defined maximum per period of usage,

- supports fees with different legal status (e.g. public tax, private toll),
- supports 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,
- supports overlapping geographic toll domains,
- supports adaptations to changes in
  - tolled infrastructure,
  - tariffs, and
  - participating toll schemes, and
- supports the provision of trust guarantees by the toll service provider to the toll charger for the data originated from the Front End.

Electronic fee collection — Application interface definition for autonomous systems —

Part 1: Charging

1 Scope

This part of ISO 17575 defines the format and semantics of the data exchange between a Front End (OBE plus optional proxy) and corresponding Back Ends in autonomous toll schemes. It defines the data elements that are used to generate charge reports containing information about the road usage of a vehicle for certain time intervals, sent from the Front End to the Back End. It also defines the data that can be used to re-configure the ongoing process of gathering charge relevant information in the Front End. The scope is shown in Figure 1.

The constitution of the charge report is dependent on configuration data that are assumed to be present in the Front End. The assembly of charge reports can be configured for each individual toll scheme according to local needs. Charge reports generated in accordance with this part of ISO 17575 are consistent with the requirements derived from the architectural concept defined in ISO 17573:2010.

The definitions in this part of ISO 17575 comprise

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

— data for supporting security mechanisms,

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

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

— account data for managing a payment account,

— versioning data, and

— compliance checking data, i.e. data imported from ISO 12813:2015, which are required in compliance checking communication.

Annex A contains the data type specifications using ASN.1 notation.

The protocol implementation conformity statements (PICS) proforma are provided in Annex B.

Annex C provides a graphical presentation of the structure of the data elements described in Clause 7.

Annex D provides information on how this part of ISO 17575 can be used in EETS environment and how the requirements that are specified in the EU-Decision 2009/750 are addressed by this standard.

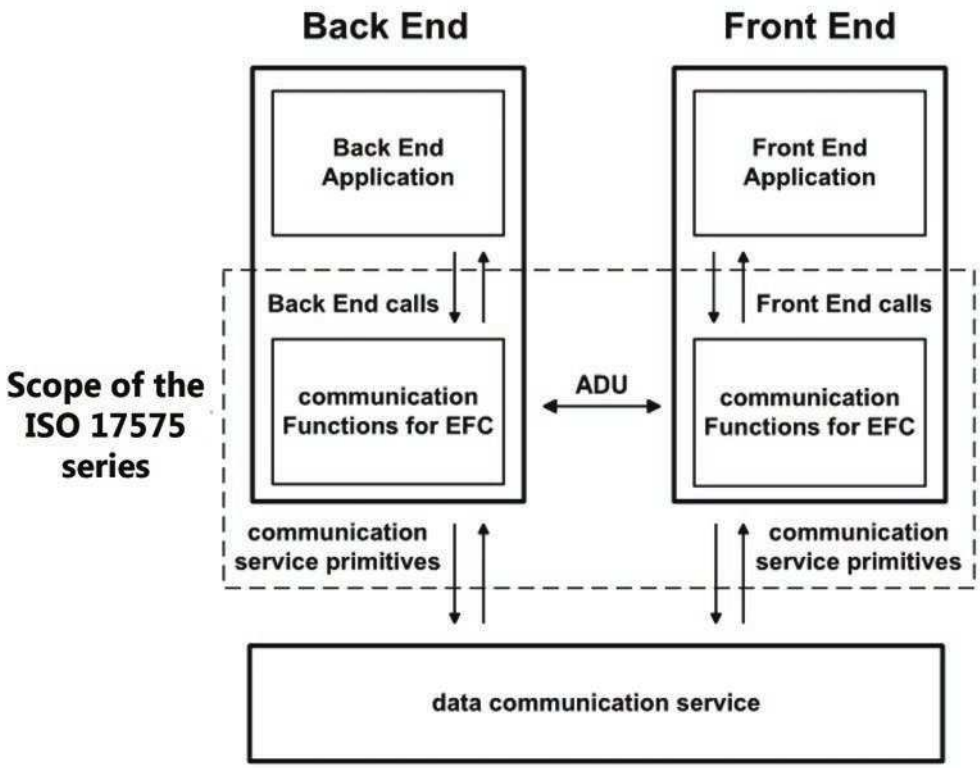

Figure 1 — Scope of ISO 17575-1

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6709:2008, *Standard representation of geographic point location by coordinates*

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

ISO/IEC 8825-2:2008, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER) — Part 2*

ISO/IEC 9594-8:2014, *Information technology — Open Systems Interconnection — The Directory — Part 8: Public-key and attribute certificate frameworks*

ISO 12813:2015, *Electronic fee collection— Compliance check communication for autonomous systems*

ISO 13141:2015, *Electronic fee collection— Localisation augmentation communication for autonomous systems*

ISO 14906:2011/Amd1:2015, *Electronic fee collection — Application interface definition for dedicated short-range communication*

ISO 17573:2010, *Electronic fee collection — Systems architecture for vehicle-related tolling*

ISO 17575-3:2016, *Electronic fee collection— Application interface definition for autonomous systems— Part 3: Context data*

NIMA TR8350.2, Third Edition — Amendment 1, January 2000, Department of Defense — World Geodetic System 1984, Its Definition and Relationships With Local Geodetic Systems, issued by National Imagery and Mapping Agency (NIMA), US Department of Defense

IETF RFC 5035:2007-08, Enhanced Security Services (ESS) Update: Adding CertID Algorithm Agility

3 Terms and definitions

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

3.1
area charging
charging based on road usage within a given area

3.2
attribute
addressable package of data consisting of a single data element or structured sequences of data elements

3.3
authenticator
data, possibly encrypted, that is used for authentication

[SOURCE: EN 15509:2014, 3.3]

3.4
Back End
part of a back office system interfacing to one or more *Front Ends* (3.12)

3.5
charge object
geographic or road related object for the use of which a charge is applied

3.6
charge report
information containing road usage and related information originated at the *Front End* (3.12)

3.7
cordon
border line of an area

3.8
cordon charging
charging for the crossing of a *cordon* (3.7)

3.9
data element
coded information, which might itself consist of lower level information structures

3.10
data group
class of closely related *attributes* (3.2)

3.11
toll cluster
group of toll schemes operating under a common agreement providing interoperability for road users having a contract with a toll service provider being part of the cluster

3.12
Front End
part of a tolling system consisting of an OBE and possibly a *proxy* (3.13) where road tolling information and usage data are collected and processed for delivery to the *Back End* (3.4)

[SOURCE: ISO/TS 19299:2015, 3.17]

3.13
proxy
optional part of a *Front End* (3.12) that communicates with external equipment and processes the data received into an agreed format to be delivered to the *Back End* (3.4)

3.14
road section charging
tolling principle where the fee is due if predefined sections of roads are used

3.15
tariff modifier
four classes (vehicle class, time class, user class and location class) on which the tariff depends for a given road usage

3.16
toll
charge, tax or duty levied in connection with using a vehicle in a *toll domain* (3.19)

[SOURCE: ISO/TS 19299:2015, 3.42, modified — "any" has been deleted from before "charge".]

3.17
toll context
logical view as defined by *attributes* (3.2) and functions of the basic elements of a toll scheme consisting of a single basic tolling principle, a spatial distribution of the *charge objects* (3.5) and a single behaviour of the related *Front End* (3.12)

3.18
toll context data
information defined by the responsible toll charger as necessary to establish the *toll* (3.16) due for using a vehicle on a particular *toll context* (3.17) and to conclude the toll transaction

[SOURCE: ISO 12855:2015, 3.15]

3.19
toll domain
area or a part of a road network where a certain *toll regime* (3.20) is applied

[SOURCE: ISO 17573:2010, 3.18, modified — "certain" has been added.]

3.20
toll regime
set of rules, including enforcement rules, governing the collection of *toll* (3.16) in a *toll domain* (3.19)

[SOURCE: ISO 17573:2010, 3.20]

3.21
transaction
whole of the exchange of information between two physically separated communication facilities

3.22
transaction model
functional model describing the structure of electronic payment transactions

[SOURCE: ISO 14906:2011, 3.25, modified — "fee collection" has been deleted.]

4 Abbreviated terms

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

ADU	Application data unit (ISO 14906)
ASN.1	Abstract Syntax Notation One (ISO/IEC 8824-1)
CCC	Compliance check communication (ISO 12813)
CN	Cellular network
DSRC	Dedicated short-range communication (ISO 14906)
EFC	Electronic fee collection (ISO 14906)
LAC	Localisation augmentation communication (ISO 13141)
GNSS	Global Navigation Satellite System
GPS	Global positioning system
GSM	Global system for mobile communications
HMI	Human-machine interface
MAC	Message authentication code
OBE	On-board equipment
PICS	Protocol implementation conformance statements
RSE	Roadside equipment (ISO 14906)
VAT	Value added tax

5 Architectural considerations

5.1 Business architecture

This clause deals with the complete ISO 17575-series, i.e. ISO 17575-1 to ISO 17575-3.

The definitions of ISO 17575 are relevant not only for interoperable EFC (as described below) but for all possible autonomous EFC schemes.

ISO 17575 complies with the business architecture defined in ISO 17573:2010. 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 2).

As defined in ISO 17573:2010, the role of the toll charger includes the provision of the toll context data. The ISO 17575 concept defines a one-to-one relationship between toll charger ID and toll context. Therefore, it is justified to use the data type provider, as defined in ISO 14906:2011/Amd1:2015, Annex A, to identify a toll context. If a toll charger operates more than one toll scheme, separate identifiers shall be applied for in the central registry as defined in ISO 14906:2011/Amd1:2015.

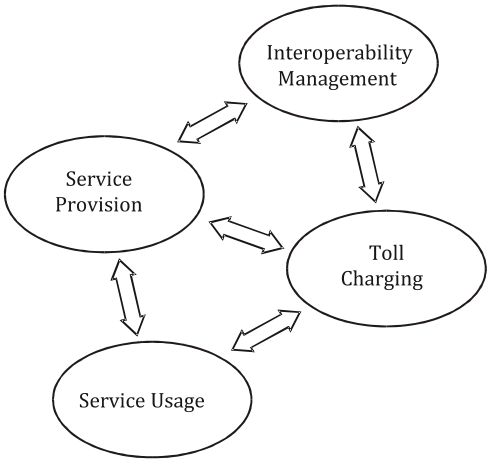

Figure 2 — The role-based model underlying ISO 17575

Toll service providers issue OBE to the users of the road infrastructure. Toll service providers are responsible for operating 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 toll service provider delivers charging data to several toll chargers, and, in general, each toll charger receives charging data from more than one toll service provider. Interoperability management, as shown in Figure 2, comprises all specifications and activities that define and maintain a set of rules that govern the overall toll charging environment.

5.2 Technical architecture

The technical architecture shown in Figure 3 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, tariff determination can be done with OBE tariff tables and processing, or with an off-board component.

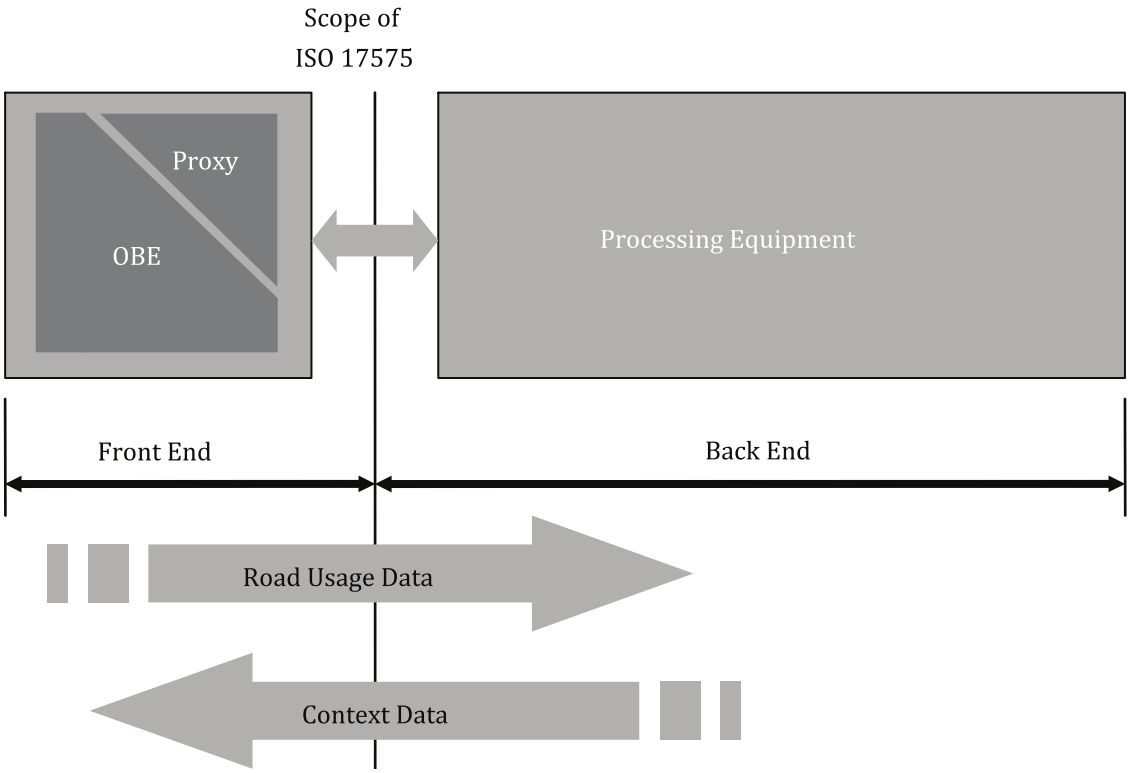

Figure 3 — Assumed technical architecture and interfaces

The combined functionality of OBE and proxy is denoted as Front End. A Front End implementation where processing is predominately on the 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 3. Both extremes of architectural choice have their merits and are one area where manufacturers compete with individual allocations of functionality between on-board and central resources.

NOTE Especially for thin, but also for smart client, OBE manufacturers might devise a wide variety of optimizations of the transfer of charge data between OBE and off-board components, where proprietary algorithms are used for data reduction and data compression.

5.3 Location of the specification interface

In order to abstract from, and become independent of, these architectural implementation choices, the primary scope of ISO 17575 is the data exchange between Front End and Back End (see the corresponding vertical line in Figure 3). For every toll regime, the Back End shall send toll context data, i.e. a description of the toll regime in terms of charge objects, charging rules and, if required, the tariff scheme to the Front End, and shall receive usage data from the Front End.

It also has to be noted that the distribution of tasks and responsibilities between toll service provider and toll charger will vary individually. Depending on the local legal situation, toll chargers will require "thinner" or "thicker" data, and might or might not leave certain data processing tasks to toll service providers. Hence, the data definitions in ISO 17575 may be useful on several interfaces.

ISO 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.

6 Procedural requirements

6.1 General

This part of ISO 17575 is intended to be used in autonomous toll systems set up according to the overall architecture described in ISO 17573:2010.

It defines the format and semantics of charge reports and charge report responses, which are part of the end-to-end information flow.

6.2 Toll collection process

On-board equipment (OBE) collects data on the road usage of an individual vehicle. These data are aggregated and processed regarding their relevance for charging either in the OBE or in a proxy. The combination of OBE and proxy is referred to as a Front End.

This part of ISO 17575 defines the data required for communicating charge relevant road usage data for an individual vehicle from the Front End to the Back End. The Front End shall accumulate road usage data into charge reports and send the charge reports to the Back End. The Back End shall confirm reception of a charge report (`ChargeReport`) with a charge report response (`ChargeReportResponse`).

For supporting an uninterrupted chain of trust this part of ISO 17575 supports the authentication of several data structures using the following data types:

— `AuthenticatedChargeReport`;

— `AuthenticatedChargeReportResponse`;

— `AuthenticatedUsageStatement`;

— `AuthenticatedReloadAccount`;

— `AuthenticatedNewAccountLimit`;

— `AuthenticatedAddToAccount`.

NOTE The use of and the combination of these data types with their unauthenticated counterparts are left to agreements between the parties implementing this part of ISO 17575. For example, an `AuthenticatedChargeReport` can be combined with an unauthenticated `ChargeReportResponse`, if this is considered appropriate under specific circumstances.

6.3 Charge report

All data elements comprising the type `ChargeReport` are coded as optional (except for the `usageStatementList`, which ultimately also contains only optional elements).

For every toll context, the Back End shall send context data to the Front End. Context data is a description in terms of charge objects, charging rules and, if required, the tariff scheme. The definition of the context data can be found in ISO 17575-3:2016.

Toll context data defines which data elements shall be present and which shall not. The Back End shall communicate the toll context data defining the requested charge report contents to the Front End before the OBE is expected to collect road usage data. Upon reception of toll context data the Front End shall start to collect, process and accumulate road usage data into charge reports as requested. Toll context data shall also define upon which events charge reports shall be communicated.

NOTE 1 The charge report content requirements defined by the toll context data allow setting the report contents as required by the properties of the toll regime. These properties include the basic toll system types such as

— road section charging (the charge relevant parameter is the sum of the road section lengths or tariff used by the vehicle),

— area charging (the charge relevant parameter is either the distance driven inside the area or the time stayed inside the area), and

— cordon charging (the charge relevant parameter is the event of crossing the cordon around an area).

NOTE 2 Depending on local needs, toll chargers may require more or less processed data to varying levels of detail. Privacy considerations, enforcement approach and legal nature of the charge will also influence the choices agreed between toll charger and toll service provider regarding the requested contents of charge reports.

Charge reports support

— reporting a list of charge objects that are declared as being used by the vehicle including associated tariff modifiers; this report may or may not include the calculated fee or tax,

— reports of road usage sessions within a single set of tariff modifiers; this report may or may not include the calculated fee or tax,

— report of contiguous sessions on a toll road or area where just the aggregated fee and the associated reference time is reported,

— reports where only the total fee within a predefined report period is forwarded (in this case it is anticipated that other means, outside the scope of this part of ISO 17575, are used to allow a certain degree of validation of the charging process), and

— any combination of the reports listed above.

6.4 Charge report response

The Back End shall respond to every received charge report with a charge report response. A description of which optional elements of the attribute `ChargeReportResponse` are present is not defined in this part of ISO 17575.

NOTE The contents of the charge report response depend on the make and type of the Front End and on the application software of the Front End and Back End as defined by the business requirements of the individual toll service provider. This part of ISO 17575 only offers data elements for the response but does not impose restrictions upon the implementation and business choices by requiring mandatory content.

7 Data elements

7.1 Overview of data elements

Data elements are grouped in logical groups for readability only.

The data group **Reporting** contains the main data elements of the charge report communication. These elements are the top level, overarching data structures containing all data elements described in this part of ISO 17575.

The data group **General** contains data elements and types that are not explicitly part of other groups.

The data group **Security** contains the data structures necessary for implementing authenticated exchange of data using security mechanisms.

The data group **Contract** contains data elements and types related to road user contract information.

The data group **Usage** contains the information necessary to describe the usage of infrastructure causing eligibility for fees. These data are necessary for calculating the charges and for setting up correct bills and for settling disputes. The main data elements of this group present in the charge report and charge report response are, respectively, `usageStatementList` and `dataReceived`.

The data group **Account** contains the elements necessary to ensure that the correct account (and road user) is charged with the toll fees. The elements in the group account are used for managing road user accounts in the Front End. These Front End accounts can contain the following types of data:

— credit: the account holds a value corresponding to a monetary amount;

— distance: the account holds a value representing a distance;

— time: the account holds a value representing a point in time;

— duration: the account holds a value representing time duration;

— event: the account holds a value representing a number of events.

The main data elements of this group present in the charge report and charge report response are, respectively, `accountStatus` and `accountUpdate`.

NOTE The kind of event counted in the respective option of the account data type is left to the implementation.

The data group **Versioning** contains data elements for version control of elements on the OBE.

The data group **Compliance Checking** provides information exchanged in compliance checking communication (CCC), as defined in ISO 12813:2015. Some of the data exchanged by CCC are already covered by other data elements, but for complete information about the content of CCC the data in this group are necessary.

7.2 Reporting

The two data types `ChargeReport` and `ChargeReportResponse` described in 7.2.1 and 7.2.2 cover the complete charge report communication.

7.2.1 ChargeReport

The data type `ChargeReport` comprises the following data elements:

— `protocolVersion`;

— `obeId`;

— `vehicleLPNr`;

— `paymentMeans`;

— `serviceProviderContract`;

— `tollContext`;

— `chargeReportFinalRecipient`;

— `timeOfReport`;

— `reportPeriod`;

— `versionInfo`;

— `usageStatementList`;

— `sumVatForThisSession`;

— `accountStatus`;

— `sumVatForThisSession`;

— `chargeReportCounter`;

— `mileage`;

— `listOfCccAttributes`.

Those are the basic data elements for charge communication. A data element of the type `ChargeReport` is sent by the Front End whenever it is necessary to transmit charge data to the Back End.

The report contains the necessary data for identifying the (already registered) OBE and contract. It relays the information on usage of chargeable infrastructure by the vehicle and provides additional information for plausibility checks and accounting procedures (e.g. VAT calculations).

The data elements contained in this structure pertain to logical data groups and are detailed below.

For ensuring an uninterrupted chain of trust, security mechanisms are implemented for proof of authenticity and integrity of the data transmitted in `ChargeReport`. For supporting non-repudiation and for generating court-proof evidence it is therefore recommended to use the data type `AuthenticatedChargeReport`. The use of this data type is also described below.

7.2.2 ChargeReportResponse

In response to a charge report, the Back End answers with a data element of the type `ChargeReportResponse`. This data type consists of the following components:

— `chargeReportRespSender`;

— `dataReceived`;

— `versionsResponse`;

— `obeStatusForDriver`;

— `accountUpdate`.

These data provide a confirmation of the data reception at the application level. In addition, feedback to the Front End (e.g. request for updates, change in OBE status) is provided.

The data types and elements contained in this structure and the ones constituting those pertain to logical data groups and are detailed below.

For ensuring an uninterrupted chain of trust, security mechanisms are implemented for proof of authenticity and integrity of the data transmitted in `ChargeReportResponse`. For supporting non-repudiation and for generating court-proof evidence it is therefore recommended to use the data type `AuthenticatedChargeReportResponse`. The use of this data type is also described below.

7.3 Data group General

7.3.1 timeOfReport

The data element `timeOfReport` gives the date and time when the charge report was compiled for transmission.

NOTE All data elements giving time information use the local time at the location of the vehicle.

7.3.2 reportPeriod

The data element `reportPeriod` gives the time period covered by the respective `ChargeReport`.

7.3.3 sumVatForThisSession

The data element `sumVatForThisSession` contains the aggregated VAT for the fees communicated in the respective charge report. Its associated data type is `PaymentFee`, which is defined in and imported from ISO 14906:2011/Amd1:2015.

7.3.4 chargeReportCounter

The data element `chargeReportCounter` gives the number of the current charge report generated by a given OBU. This counter shall be incremented by the Front End after compilation of a charge report, facilitating distinction between charge reports. In the case of overflow the counter starts again at 0. The values of `chargeReportCounter` are determined for each OBU separately; there is no correlation (or uniqueness) between different OBUs.

7.3.5 mileage

The data element `mileage` contains the reading of an internal mileage counter of type `Distance`. The counter shall start at 0 for a new OBE and continuously count all vehicle mileage while the OBE is active; the counter shall restart from zero in case of overflow (i.e. when reaching the maximum value).

7.3.6 Distance

The data type `Distance` contains distance values. The first element (`dist`) is an integer containing the distance value itself, the second (`disUnit`) is used for defining the unit of distance used. It can have the values `kilometres`, `miles`, `metres`, `yards`, `feet`, `decimetres` and `quartermetres`. The last option (unit 0,25 metres) is necessary to support direct compatibility with the altitude values used in ISO 12813 and in ISO 13141.

7.3.7 Position

The data type `Position` defines a geographical position, with the elements `longitude` and `latitude` as defined in ISO 6709:2008 and an element `altitude` as defined in this part of ISO 17575.

To translate `longitude`, `latitude` and `altitude` coordinates to the corresponding real position on earth or vice-versa the geodetic datum shall be WGS84(G1150), according to NIMA TR8350.2 version 3, per default unless another earth-centred, earth-fixed, polar coordinate geodetic datum is agreed mutually by the toll charger and toll service provider.

Furthermore, by default it is allowed to use any earth-centred, earth-fixed, polar coordinate geodetic datum, as long as the maximum datum displacement relative to the geodetic datum prescribed is acceptable to the toll charger of the related toll domain.

The maximum tolerated datum displacement, also called datum shift, should not exceed 0,4 metres.

NOTE The recommended maximum tolerated displacement allows, for example, for using one of the International Terrestrial Reference Frames (ITRF), the Russian PZ90.2 or one of the European Terrestrial Reference Frame (ETRF) as geodetic datums alternative to the WGS84.

The calculated datum displacement should be determined according to the definitions in ASME Y14.5: 2009.

7.3.8 Period

The data type `Period` defines a period of time, defined by the date and time of its beginning (`beginOfPeriod`) and of its end (`endOfPeriod`).

7.3.9 Duration

The data type `Duration` defines a time span, defined by the actual value (`dur`) of the ASN.1 type `INTEGER` (4 Bytes), and the respective unit (`durUnit`), which can have one of the values `seconds`, `minutes`, `hours`, `days` or `months`.

7.4 Data group Security

7.4.1 AuthenticatedChargeReport

This data type contains the following elements:

— `chargeReportPer`;

— `messageAuthenticator`.

The `chargeReportPer` is a container (BIT STRING) holding a data element of type `ChargeReport`, which is encoded using ASN.1 Packed Encoding Rules aligned as defined in ISO/IEC 8825-2:2008. The `chargeReportPer` is used for calculating the `messageAuthenticator` of type `MessageAuthenticator`.

7.4.2 AuthenticatedChargeReportResponse

This data type contains the following elements:

— `chargeReportResponsePer`;

— `messageAuthenticator`.

The `chargeReportResponsePer` is a container (BIT STRING) holding a data element of type `ChargeReport`, which is encoded using ASN.1 Packed Encoding Rules aligned as defined in ISO/IEC 8825-2:2008. The `chargeReportResponsePer` is used for calculating the `messageAuthenticator` of type `MessageAuthenticator`.

7.4.3 AuthenticatedUsageStatement

This data type contains the following elements:

— `usageStatementPer`;

— `messageAuthenticator`.

The `usageStatementPer` is a container (BIT STRING) holding a data element of type `ChargeReport`, which is encoded using ASN.1 Packed Encoding Rules aligned as defined in ISO/IEC 8825-2:2008. The `usageStatementPer` is used for calculating the `messageAuthenticator` of type `MessageAuthenticator`.

7.4.4 AuthenticatedReloadAccount

This data type contains the following elements:

— `reloadAccountPer`;

— `messageAuthenticator`.

The `reloadAccountPer` is a container (BIT STRING) holding a data element of type `ChargeReport`, which is encoded using ASN.1 Packed Encoding Rules aligned as defined in ISO/IEC 8825-2:2008. The `reloadAccountPer` is used for calculating the `messageAuthenticator` of type `MessageAuthenticator`.

7.4.5 AuthenticatedNewAccountLimit

This data type contains the following elements:

— `setAccountPer`;

— `messageAuthenticator`.

The `setAccountPer` is a container (BIT STRING) holding a data element of type `ChargeReport`, which is encoded using ASN.1 Packed Encoding Rules aligned as defined in ISO/IEC 8825-2:2008. The `setAccountPer` is used for calculating the `messageAuthenticator` of type `MessageAuthenticator`.

7.4.6 AuthenticatedAddToAccount

This data type contains the following elements:

— `addToAccountPer`;

— `messageAuthenticator`.

The `addToAccountPer` is a container (BIT STRING) holding a data element of type `ChargeReport`, which is encoded using ASN.1 Packed Encoding Rules aligned as defined in ISO/IEC 8825-2:2008. The `addToAccountPer` is used for calculating the `messageAuthenticator` of type `MessageAuthenticator`.

7.4.7 MessageAuthenticator

This data type contains an authenticator, offering a choice of either symmetric (`mac` of type `MacMessageAuthenticator`) or asymmetric (`signature` of type `MessageAuthenticatorEfc`) algorithms. It also contains the information for specifying the algorithm used.

The padding algorithm used in this technical specification shall be padding method 2 defined in ISO/IEC 9797-1:2011, 6.3.3. For messages authenticated by a signature, the padding algorithm defined in this subclause shall be used but the padding shall not be added to the message for transmission.

7.4.8 MacMessageAuthenticator

This data type contains all the data elements necessary (`algorithmIdentifier`, `masterKeyRef`, `keyDerivationID`, and the calculated `authenticator` itself) for symmetric MAC authentication. The respective basic data types are imported from the standards ISO/IEC 9594-8:2014 and IETF RFC 5035:2007-08.

7.4.9 MessageAuthenticatorEfc

This data type (and the lower level data types `TbsMessageAuthenticatorEfc`, `AlgorithmIdentifier` used in this type) contains all the data elements necessary for asymmetric signature authentication. The respective basic data types are imported from the standards ISO/IEC 9594-8:2014 and IETF RFC 5035:2007-08.

7.5 Data group Contract

7.5.1 obeId

The data element obeId is a unique identifier of the OBE. It contains two parts: one part (`manufacturerId`) is a unique identification of the OBE manufacturer and the other part (`EquipmentOBUId`) is a manufacturer-specific identification of the individual OBE. The respective data types are defined in and imported from ISO 14906:2011/Amd1:2015.

7.5.2 vehicleLPNr

The data element `vehicleLPNr` can be used either in the `chargeReport` data element or as part of the `vehicleDescription` in lower levels of the data structure. It shall only be present in the `chargeReport` if it is not used on the lower levels. The respective data type is defined in and imported from ISO 14906:2011/Amd1:2015.

7.5.3 paymentMeans

The data element `paymentMeans` is a unique identification of an individual account; the respective data type is defined in and imported from ISO 14906:2011/Amd1:2015.

7.5.4 serviceProviderContract

The data element `serviceProviderContract` identifies the toll service provider and the contract type to which the charge report data pertain. The respective data type is defined in and imported from ISO 14906:2011/Amd1:2015.

NOTE 1 It is the responsibility of the toll service provider to keep a consistent relationship between `obeId`, `paymentMeans` and `serviceProviderContract` in their database.

NOTE 2 The data element `serviceProviderContract` is of the type `EFC-ContextMark`. Be aware that the term context in this name and in the data element `contextVersion` contained therein does not refer to the toll context as defined in this part of ISO 17575, but rather to the contract between toll service provider and toll service user.

7.5.5 tollContext

The data element `tollContext` identifies the toll context to which the charge report relates. Since there is a one-to-one relationship between toll charger and toll context, it is justified to use the type `Provider` for this data element.

The data type `Provider` is imported from ISO 14906:2011/Amd1:2015.

7.5.6 chargeReportFinalRecipient

The data element `chargeReportFinalRecipient` identifies the entity which is the final destination of the respective usage data. If used at all, this information is communicated to the Front End with the context data (see ISO 17575-3:2016).

This data element is of the data type `Provider`, which is imported from ISO 14906:2011/Amd1:2015.

NOTE 1 Small toll contexts (e.g. a bridge) might be embedded within large ones (e.g. a national toll scheme). In this case the toll charger of the large one assumes the role of toll charger for all external purposes, but internally the final destination of the charge reports is the toll charger of the small toll context. This latter operator is identified with the data element `chargeReportFinalRecipient`.

NOTE 2 The data element `chargeReportFinalRecipient` can be included either in a data element of type `ChargeReport`, of type `UsageStatement` or in a data element of type `DetectedChargeObject`. Dealing with or avoiding contradictions resulting from use of this element in more than one level simultaneously is left to the respective implementation.

7.5.7 obeStatusForDriver

The data element `obeStatusForDriver` contains information for controlling the human–machine interface (HMI) elements that communicate the status of the OBE and the contract to the driver. It is of the type `SetMMIRq`, which is imported from ISO 14906:2011/Amd1:2015.

7.5.8 ObeStatus

The data element `ObeStatus` contains information about the HMI elements that communicate the status of the OBE and the contract to the driver. The following values are allowed:

— `ok`;

— `nok`;

— `contactOperator`;

— `noSignalling`.

The respective data type `SetMMIRq` is imported from ISO 14906:2011/Amd1:2015.

7.5.9 chargeReportRespSender

The data element `chargeReportRespSender` identifies the entity which received the respective charge report and which sent the charge report response.

7.6 Data group Usage

7.6.1 usageStatementList

The data element `usageStatementList` contains a list of all the usage statements of the respective charge report. For each element of this list there is a choice between elements of the types `UsageStatement` or `AuthenticatedUsageStatement`.

7.6.2 UsageStatement

The data type `UsageStatement` contains the information about actual road infrastructure use, which is required by the Back End to calculate the charges. The content of one data element of the type `UsageStatement` shall be restricted to one toll context. The data elements below this level do not hold a toll context ID.

This data type consists of the following components:

— `usageStatementId`;

— `tollContext`;

— `chargeReportFinalRecipient`;

— `aggregatedFee`;

— `sumVat`;

— `aggregatedSingleTariffClassSession`;

— `listOfChargeObjects`;

— `listOfDsrcUsageData`;

— `listOfRawUsageData`;

— `noUsage`;

— `additionalUsageInformation`.

There are four options for describing road infrastructure use, which are represented by the following data elements:

— `aggregatedFee`;

— `aggregatedSingleTariffClassSession`;

— `listOfChargeObjects`;

— `listOfRawUsageData`.

Any combination of these options is possible. For special purposes (e.g. sign in) it is also possible to use empty usage statements. Those can be marked with the flag `noUsage` (TRUE means no usage).

Security measures can be applied using the data type `AuthenticatedUsageStatement` as described in 7.4.

7.6.3 usageStatementID

The data element `usageStatementID` is an identifier of the respective usage statement. The Front End shall assign this identifier and ensure its uniqueness within the charge report.

7.6.4 aggregatedFee

The data element `aggregatedFee` contains the time period covered by the statement (`timePeriodCovered`) and the total amount of fee without VAT (`feeExclVat`) and the corresponding VAT (`sumVat`) aggregated within the time period given in `timePeriodCovered`.

7.6.5 aggregatedSingleTariffClassSession

The data element `aggregatedSingleTariffClassSession` contains the following data elements:

— `timePeriodCovered`;

— `currentTariffClass`;

— `vehicleDescription`;

— `totalDistanceCovered`;

— `numberOfDetectedEvents`;

— `obeStatus`;

— `feeExclVat`;

— `sumVat`.

It describes a single tariff class session, which is a part of a trip without any changes of charge relevant parameters. Session changes may be due to changes in vehicle category, road category, time of day, etc. The information contained is

— the time period covered by the statement (`timePeriodCovered`),

— the tariff class (`tariffClass`),

— The vehicle description (`vehicleDescription`),

— the total distance covered during the part of the trip (`totalDistanceCovered`),

— the number of events which occurred (`numberOfDetectedEvents`),

— the accumulated fee, excluding value added tax (`feeExclVat`), and

— the respective value added tax.

7.6.6 currentTariffClass

The data element `currentTariffClass` of type `TariffClassDescription` contains all information necessary for determining the tariff class as defined in the data type `TariffClass` in ISO 17575-3:2016.

In this part of ISO 17575 the data type is used to define the tariff class of one specific vehicle. Therefore there is no need for the multiplicity foreseen in ISO 17575-3:2016. A combination of `tariffClassId` and of tariff modifiers (`localVehicleClass`, `timeClass`, `locationClass`, `userClass`) defines all relevant parameters.

NOTE For tariff modifiers with high resolution see 7.6.7.

7.6.7 VehicleDescription

While in many implementations the application of the attribute `currentTariffClass` will suffice, there are cases where additional information about the vehicle is necessary. This is especially the case when vehicle characteristics go into the tariff calculation with high resolution. Therefore, the optional attribute `vehicleDescription` provides this data. This data element consists of the following data elements the types of which are all imported from ISO 14906:2011/Amd1:2015.

— `vehicleLPNr`;

— `axles`;

— `class`;

— `dimensions`;

— `specificCharacteristics`;

— `ladenWeight`;

— `weightLimits`;

— `trailerCharacteristics`.

NOTE If tariff modifiers were used with a high resolution, e.g. the `ladenWeight` with a resolution of 10kg, the definition of tariff classes would become impractical, because this would lead to a very large number of tariff classes. This is the scenario motivating the definition of the `vehicleDescription` data structure.

7.6.8 listOfChargeObjects and DetectedChargeObject

The data element `listOfChargeObjects` contains a sequence of charge object descriptions (type `DetectedChargeObject`), each of which contains the following data elements:

— ID of the detected charge object (`chargeObjectId`);

— `subObjectNumber`, which identifies a sub-object within one and the same charge object. This is, for example, needed for cordons, where the cordon is the charge object, but there is a need for distinction between the various entry and exit points to this charge object. These cordon crossings are identified with sub-object numbers;

— time of passage of the charge object (`timeWhenUsed`);

— reading of the internal virtual mileage counter at the time of use of the charge object (`mileageWhenUsed`);

— tariff class (`currentTariffClass`);

— vehicle description (vehicleDescription);

— status of the OBE (obeStatus);

— accumulated fee, excluding value added tax (feeExclVat);

— respective value added tax sumVat;

— charge object detection mode (chargeObjDetectionMode).

Charge objects can be marked as inferred or as detected with the support of a location augmentation beacon by setting the flag chargeObjDetectionMode accordingly.

An inferred charge object is one which was not detected by the evaluation of primary sensor data using regular rules defined for recognising charge objects, but inferred from the overall trip logic. In this case chargeObjDetectionMode is set to inferred.

For implementation reasons in special cases, the normal charge object detection technology could be supported (or even overruled) by localization augmentation beacons (LAC beacons), which communicate a location or even the passage of a given charge object directly, usually using short-range communication technology (e.g. DSRC). In this case chargeObjDetectionMode is set to lac.

7.6.9 ChargeObjectId

The data element ChargeObjectId identifies a charge object (e.g. road section, cordon) according to the local definition of the toll charger owning the respective toll scheme. It contains the identifier of the final recipient of the respective usage data (chargeReportFinalRecipient, see 7.5.6), and a designation number (chargeObjectDesignation).

7.6.10 ListOfRawUsageData, measuredRawData

The data element ListOfRawUsageData contains the following data elements:

— a list (rawDataList) containing a series of data elements (measuredRawData);

— tariff information (currentTariffClass) relevant for fee calculation;

— the vehicle description (vehicleDescription).

The measuredRawData data elements contain the following information:

— position (measuredPosition);

— time (timeWhenMeasured);

— data according to the format NMEA 0183 (as defined by the National Marine Electronics Association) (nmeaData);

— additional information (additionalGnssData).

The data elements nmeaData and additionalGnssData should only be used sparingly, e.g. for monitoring purposes to avoid excessive amounts of data occurring on the Front End interface.

NOTE This part of ISO 17575 does not define compression algorithms optimised for raw road usage data. Compression and data reduction can be used for data transfer, but are not supported at application level.

7.6.11 NmeaData

The data elements in NmeaData are a selection of the elements listed in NMEA 0183. This selection represents the Recommended Minimum Sentence C (RMC), but leaving out data about magnetic variation, and extended with additional data (altitude, usedSatellites, hdop).

The exact interpretation of the elements of `NmeaData` is listed in Table 1. Each digit is coded as a string character. All digits not present must be replaced by "0", decimal points are always suppressed. Capital letters in the coding column represent digits; capital letters in quotation marks must be used as spelled out.

Table 1 — Data elements of `NmeaData`

Data element	Coding	Interpretation
time	**HHMMSS.SSS**	**HH hour** **MM minute** **SS.SSS seconds**
status	**"A" or "V"**	**A ok** **V warning**
latitude	**XXYY.ZZZZ**	**XXYY.ZZZZ → XX°YY'(0.ZZZZ * 60)"**
latNS	**"N" or "S"**	**N north of equator** **S south of equator**
longitude	**XXXYY.ZZZZ**	**XXXYY.ZZZZ → XXX°YY'(0.ZZZZ * 60)"**
longEW	**"E" or "W"**	**E east of prime meridian** **W west of prime meridian**
speed	**SSS.S**	**SSS.S speed in km/h**
heading	**HHH.H**	**HHH.H track angle in degrees True**
date	**DDMMYY**	**DD day** **MM month** **YY year (00 at 2000AD)**
signalIntegrity	**One of the characters "A", "D", "E", "M", "S", "N"**	**A autonomous mode** **D differential mode** **E estimated (dead-reckoning) mode** **M manual input mode** **S simulated mode** **N data not valid**
altitude	**AAAA.A or -AAA.A**	**altitude above WGS84 in meters**
usedSatellites	**SS**	**number of satellites used to calculate the position**
hdop	**HH.H**	**horizontal dilution of precision**

7.6.12 additionalGnssData

The data elements `additionalGnssData` are intended for additional information delivered by the GNSS modules or chipsets. Possible formats include but are not restricted to

— Receiver Independent Exchange Format (RINEX),

— additional data in the format defined by the National Marine Electronics Association (NMEA 0183), or

— data in the proprietary binary formats provided by several kinds of GPS modules or chipsets.

7.6.13 ListOfDSRCUsageData

The data element `listOfDSRCUsageData` itself is optional and contains a sequence of lists of attributes (data type `AttributeList` which is defined in ISO 14906:2011/Amd1:2015, ISO 12813:2015 and ISO 13141:2015). The attribute lists shall contain EFC attributes that have been exchanged between OBE and RSE. The EFC attributes themselves are defined in ISO 14906:2011/Amd1:2015, ISO 12813:2015 and ISO 13141:2015.

Each instance of `AttributeList` shall contain the attributes exchanged in a single DSRC transaction.

NOTE 1 The `listOfDSRCUsageData` element supports the use of autonomous Front Ends operated in DSRC based EFC domains. Usually the toll charger receives DSRC transactions from their RSE and transfers them at a certain point of time to the toll service provider for checking and justification. In addition to this, there might be a strong interest by the operator of the Back End to get a copy via the CN link of the data being sent to any RSE for performing consistency checks or update central accounts. In other scenarios, there might be a requirement for autonomous Front Ends operating in DSRC based EFC domains independent of the RSE. They can generate a charge transaction in the same format as the DSRC transaction and forward it via the CN link to the Back End.

NOTE 2 Due to the nature of the DSRC protocol (master–slave principle), it cannot be guaranteed that after a DSRC transaction has taken place both the Front End and the RSE hold the same application data. Therefore, it is assumed that, for charging purposes only, data received and processed by the RSE are applicable and considered reliable.

7.6.14 additionalUsageInformation

The data element `additionalUsageInformation` can be used to transmit additional information needed by the Back End. This can, for example, be used to assign a usage statement to a certain cost centre for generating more detailed bills. The semantics and syntax of this data element are left to the respective implementation.

7.6.15 DataReceived

The data element `dataReceived` contains information about the data received in the charge report response. The respective data type `DataReceived` allows communicating the time of the report (through the data element `timeOfReport`), the corresponding value of the mileage counter (through the data element `mileage`), and the value of the charge report counter (through the data element `chargeReportCounter`).

7.7 Data group Account

7.7.1 accountStatus

With each charge report, the Front End has the option of communicating the status of the respective account. The respective data element `accountStatus` can have the following values:

— `ok`, i.e. contains a positive value above a defined threshold;

— `low`, i.e. contains a positive value below a defined threshold;

— `empty`, i.e. contains the value zero;

— `negative`, i.e. contains a value below zero.

NOTE The data element `accountStatus` is only relevant for implementations using on-board accounts.

7.7.2 accountUpdate

With each charge report response, the account in the Front End can be updated. The respective data element `accountUpdate` consist of six parts providing six options for updating the Front End account.

Either a predefined value is added to the current balance (through the data element `reloadAccount`), or the new balance is explicitly transmitted (through the data element `setAccount`). The third option adds a given quantity to the account (through the data element `addToAccount`). The update sets limits in credit, distance, time (defining a point of time until expiry), duration (defining duration until expiry) or a number of detected events.

These three options can also be communicated in an authenticated version, using the data elements `authenticatedReloadAccount`, `authenticatedSetAccount` and `authenticatedAddToAccount`.

7.7.3 reloadAccount

The data element `reloadAccount` is of the type `ReloadAccount`, which contains five Boolean data elements and the data element `reloadAuthenticator`. The Boolean values instruct the Front End application to either top up the respective type of account with a predefined value (`true`) or not (`false`). The predefined value shall be set in advance, either by the initial configuration process for the Front End or using an update mechanism and data elements.

Security measures can be applied to the data element `reloadAccount` using the data type `authenticatedReloadAccount`.

7.7.4 setAccount

The data element `setAccount` is of type `NewAccountLimit`, which sets the account to a specific value. This data type contains five elements representing the new value for a specific type of account. The value is `newCreditLimit`, `newDistanceLimit`, `newTimeLimit`, `newDurationLimit` or `newEventLimit`, depending on the type of the account.

Security measures can be applied to the data element `setAccount` using the data type `AuthenticatedNewAccountLimit`.

7.7.5 addToAccount

The data element `addToAccount` is of the type `AddToAccount`, which adds a specific value to the account. This data type contains five elements representing the value to be added to a specific type of account. This value is `addCredit`, `addDistance`, `addTime`, `addDuration` or `addEvents`, depending on the type of the account.

Security measures can be applied to the data element `addToAccount` using the data type `AuthenticatedAddToAccount`.

7.8 Data group Versioning

7.8.1 protocolVersion

The data element `protocolVersion` is of type `AidIdentifier` and is used to identify the version of this part of ISO 17575 used for the respective implementation. Since this data element and type were introduced only during the creation of this first edition of this part of ISO 17575, it is assigned the number 0. Future revisions of this part of ISO 17575 will each add a new value.

7.8.2 versionInfo

The data element `versionInfo` indicates the current status of all relevant components of the Front End and shall be used to claim that all data, hardware and software versions in the charging process are up to date. It is of the type `VersionID`, which can be given in two variants:

— `basicVersionId` is of the type `OCTET STRING`. The coding, exact content and interpretation of this element is left to the respective implementation. This variant is backwards compatible to ISO/TS 17575-1:2010;

— `extendedVersionId` implements a list of component names and associated version designations. This gives maximum flexibility in defining the current version of the Front End.

NOTE If a toll cluster contains several toll service providers and toll chargers, comprehensive version information becomes difficult to manage. For example, OBE hardware and firmware versions are usually the sole concern of the toll service providers to achieve their contractually agreed levels of performance.

7.8.3 versionResponse

The data element `versionResponse` indicates the due status of all relevant components of the Front End and can be used to ensure that all data, hardware and software versions in the charging process are up to date. It either indicates that updates are necessary in the Front End for ensuring valid operation, or confirms the validity of versions of relevant hardware, software and data components.

It is of the type `VersionID`, which is described in the definition of the data element `versionInfo` above.

7.9 Data group Compliance Checking — listOfCCCAttributes and CCCAttributes

The data element `listOfCCCAttributes` contains a sequence of data elements of the type `CCCAttributes`, distinguished by a time stamp.

The data in the structure `CCCAttributes` are defined in and imported from ISO 12813:2015. Elements of the type `CCCAttributes` contain information that can be exchanged according to ISO 12813:2015.

NOTE The data contained in the `listOfCCCAttributes` can also be transferred using the `listOfDSRCUsageData` in the elements of type `UsageStatement`. The `listOfCCCAttributes` is maintained for backward compatibility reasons.

Annex A
(normative)

Data type specifications

This annex presents the Abstract Syntax Notation One (ASN.1) definition of the data types related to the attributes specified in Clause 7 in accordance with the ASN.1 technique specified in ISO/IEC 8824-1.

The actual ASN.1 module is contained in the attached file: "ISO17575(2016) EfcAutonomousChargingV2.asn".

The encoding rules (e.g. Basic, Packed or XML Encoding Rules, BER, PER or XER) are not specified in this part of ISO 17575, except for security-related data elements as defined in 7.4.1 to 7.4.6, because the physical implementation of the ISO 17575-series interface can vary widely.

Annex B
(normative)

Protocol implementation conformance statement (PICS) proforma

B.1 General

In order to evaluate the conformance of a particular implementation, it is necessary to have a statement of capabilities and options that have been implemented. This is called an implementation conformance statement (ICS) or, more specifically when it covers transactions, a protocol implementation conformance statement (PICS).

This annex presents the PICS proforma that shall be used for the attributes defined in Clause 7 and Annex A. It provides PICS templates that shall be filled in by equipment suppliers.

B.2 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 17575 can provide information about the implementation in a standardized manner.

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

— identification of the implementation;

— identification of the protocol;

— global statement of conformance;

— PICS proforma tables.

B.3 Instructions for completing the PICS proforma

B.3.1 Definition of support

A capability is said to be supported if the implementation under test (IUT) can

— generate the corresponding operation parameters (either automatically or because the end user requires that capability explicitly), and

— 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 the IUT is able to generate it under certain 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.3.2 Status column

The status column indicates the level of support required for conformance. 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.3.3 Support column

The support column shall be completed by the supplier or implementer to indicate the level of implementation of each item. The proforma has been designed such that the values required are as follows:

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 or making the original entry illegible, and by writing the new entry alongside. All such alterations to records shall be initialized by the person who made them.

B.3.4 Item reference numbers

Each line within the PICS proforma that requires implementation details to be entered is numbered at the left-hand edge of the line. This numbering is included as a means 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 in the following sequence:

— a reference to the smallest individual response 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 labelled “a”, “b”, “c”, etc., from left to right, with this letter appended to the sequence.

B.4 PICS proforma for the Front End

B.4.1 Identification of the implementation

The following proforma (Tables B.1 to B.5) shall be used to identify the implementation for the OBE side.

Table B.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	

Table B.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	

Table B.3 — Identification of the Front End supplier

Item no.	Question	Response
1	Organisation name	
2	Contact name(s)	
3	Address	
4	Telephone number	
5	e-mail address	
6	Other information	

Table B.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	

Table B.5 — Identification of ISO 17575

Item no.	Question	Response
1	Title, reference no., publication date	
2	ISO 17575 version (edition) no.	
3	Implemented addenda	
4	Implementer's guide version no.	
5	Implementation defect reports (ref. no.)	
6	Other information	

B.4.2 Global statement of conformance

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

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

B.4.3 PICS proforma tables

This part of the PICS proforma (Tables B.6 to B.11) identifies the supported application context, communication services and attributes (ADU) for the Front End side.

Table B.6 — Mandatory data elements

Item no.	Element	Reference	Status	Support
1	ChargeReport	7.2.1	m	
2	ChargeReportResponse	7.2.2	m	
3	UsageStatement	7.6.2	m	

Table B.7 — Charge report data elements

Item no.	Element	Reference	Status	Support
1	AuthenticatedChargeReport	7.4.1	o	
2	protocolVersion	7.8.1	m	
3	obeId	7.5.1	o	
4	vehicleLPNr	7.5.2	o	
5	paymentMeans	7.5.3	o	
6	serviceProviderContract	7.5.4	m	
7	tollContext	7.5.5	o	
8	chargeReportFinalRecipient	7.5.6	o	
9	timeOfReport	7.3.1	o	
10	reportPeriod	7.3.2	o	
11	versionInfo	7.8.2	o	
12	usageStatementList	7.6.1	m	
13	sumVatForThisSession	7.3.3	o	
14	accountStatus	7.7.1	o	
15	chargeReportCounter	7.3.4	o	
16	mileage	7.3.5	o	
17	listOfCCCAttributes	7.9	o	

Table B.8 — Charge report response data elements

Item no.	Element	Reference	Status	Support
1	AuthenticatedChargeReportResponse	7.4.2	o	
2	chargeReportRespSender	7.5.9	o	
3	dataReceived	7.6.15	o	
4	versionsResponse	7.8.3	o	
5	obeStatusForDriver	7.5.7	o	
6	accountUpdate	7.7.2	o	

Table B.9 — Usage statement data elements

Item no.	Element	Reference	Status	Support
1	usageStatementID	7.6.3	o	
2	tollContext	7.5.5	o	
3	chargeReportFinalRecipient	7.5.6	o	
4	aggregatedFee	7.6.4	o	
5	sumVat	7.3.3	o	
6	aggregatedSingleTariffClassSession	7.6.5	o	
7	listOfChargeObjects	7.6.8	o	
8	listOfDSRCUsageData	7.6.13	o	
9	listOfRawUsageData	7.6.10	o	
10	noUsage	7.6.2	o	
11	additionalUsageInformation	7.6.14	o	

Table B.10 — Data requirements regarding account types

Item no.	Account type	Reference	Status	Support
1	Credit	7.7	o	
2	Distance	7.7	o	
3	Time	7.7	o	
4	Duration	7.7	o	
5	Events	7.7	o	

Table B.11 — Data requirements regarding security

Item no.	Element	Reference	Status	Support
1	MacMessageAuthenticator	7.4.8	o	
2	MessageAuthenticatorEfc	7.4.9	o	
3	AuthenticatedReloadAccount	7.4.4	o	
4	AuthenticatedNewAccountLimit	7.4.5	o	
5	AuthenticatedAddToAccount	7.4.6	o	

B.5 PICS proforma for the Back End

B.5.1 Identification of the implementation

The following proforma (Tables B.12 to B.16) shall be used to identify the implementation for the Back End side.

Table B.12 — Identification of PICS

Item no.	Question	Response
1	Date of statement (DD/MM/YY)	
2	PICS serial number	
3	System conformance statement cross reference	

Table B.13 — Identification of the implementation and/or system

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

Table B.14 — Identification of the Back End supplier

Item no.	Question	Response
1	Organisation name	
2	Contact name(s)	
3	Address	
4	Telephone number	
5	e-mail address	
6	Other information	

Table B.15 — 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	

Table B.16 — Identification of ISO 17575

Item No.	Question	Response
1	Title, reference no., publication date	
2	ISO 17575 version (edition) no.	
3	Implemented addenda	
4	Implementer's guide version no.	
5	Implementation defect reports (ref. no.)	
6	Other information	

B.5.2 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 PICS, with an explanation of why the implementation is non-conforming, on pages attached to the PICS proforma.

B.5.3 PICS proforma tables

This part of the PICS proforma (Tables B.17 to B.22) identifies the supported application context, communication services and attributes (ADU) for the Back End side.

Table B.17 — Mandatory data elements

Item no.	Element	Reference	Status	Support
1	ChargeReport	7.2.1	m	
2	ChargeReportResponse	7.2.2	m	
3	UsageStatement	7.6.2	m	

Table B.18 — Charge report data elements

Item no.	Element	Reference	Status	Support
1	AuthenticatedChargeReport	7.4.1	o	
2	protocolVersion	7.8.1	m	
3	obeId	7.5.1	o	
4	vehicleLPNr	7.5.2	o	
5	paymentMeans	7.5.3	o	
6	serviceProviderContract	7.5.4	m	
7	tollContext	7.5.5	o	
8	chargeReportFinalRecipient	7.5.6	o	
9	timeOfReport	7.3.1	o	
10	reportPeriod	7.3.2	o	
11	versionInfo	7.8.2	o	
12	usageStatementList	7.6.1	m	
13	sumVatForThisSession	7.3.3	o	
14	accountStatus	7.7.1	o	
15	chargeReportCounter	7.3.4	o	
16	mileage	7.3.5	o	
17	listOfCCCAttributes	7.9	o	

Table B.19 — Charge report response data elements

Item no.	Element	Reference	Status	Support
1	AuthenticatedChargeReportResponse	7.4.2	o	
2	chargeReportRespSender	7.5.9	o	
3	dataReceived	7.6.15	o	
4	versionsResponse	7.8.3	o	
5	obeStatusForDriver	7.5.7	o	
6	accountUpdate	7.7.2	o	

Table B.20 — Usage statement data elements

Item no.	Element	Reference	Status	Support
1	usageStatementID	7.6.3	o	
2	tollContext	7.5.5	o	
3	chargeReportFinalRecipient	7.5.6	o	
4	aggregatedFee	7.6.4	o	
5	sumVat	7.3.3	o	
6	aggregatedSingleTariffClassSession	7.6.5	o	
7	listOfChargeObjects	7.6.8	o	
8	listOfDSRCUsageData	7.6.13	o	
9	listOfRawUsageData	7.6.10	o	
10	noUsage	7.6.2	o	
11	additionalUsageInformation	7.6.14	o	

Table B.21 — Data requirements regarding account types

Item no.	Account type	Reference	Status	Support
1	Credit	7.7	o	
2	Distance	7.7	o	
3	Time	7.7	o	
4	Duration	7.7	o	
5	Events	7.7	o	

Table B.22 — Data requirements regarding security

Item no.	Element	Reference	Status	Support
1	MacMessageAuthenticator	7.4.8	o	
2	MessageAuthenticatorEfc	7.4.9	o	
3	AuthenticatedReloadAccount	7.4.4	o	
4	AuthenticatedNewAccountLimit	7.4.5	o	
5	AuthenticatedAddToAccount	7.4.6	o	

Annex C
(informative)

Hierarchical data structure illustration

The data types and associated coding related to the data elements described in Clause 7, are defined using the Abstract Syntax Notation One (ASN.1) technique in accordance with ISO/IEC 8824-1. 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 C.1 and Figure C.2. Only the major elements are shown, which is also the reason for level 5 being empty in Figure C.1.

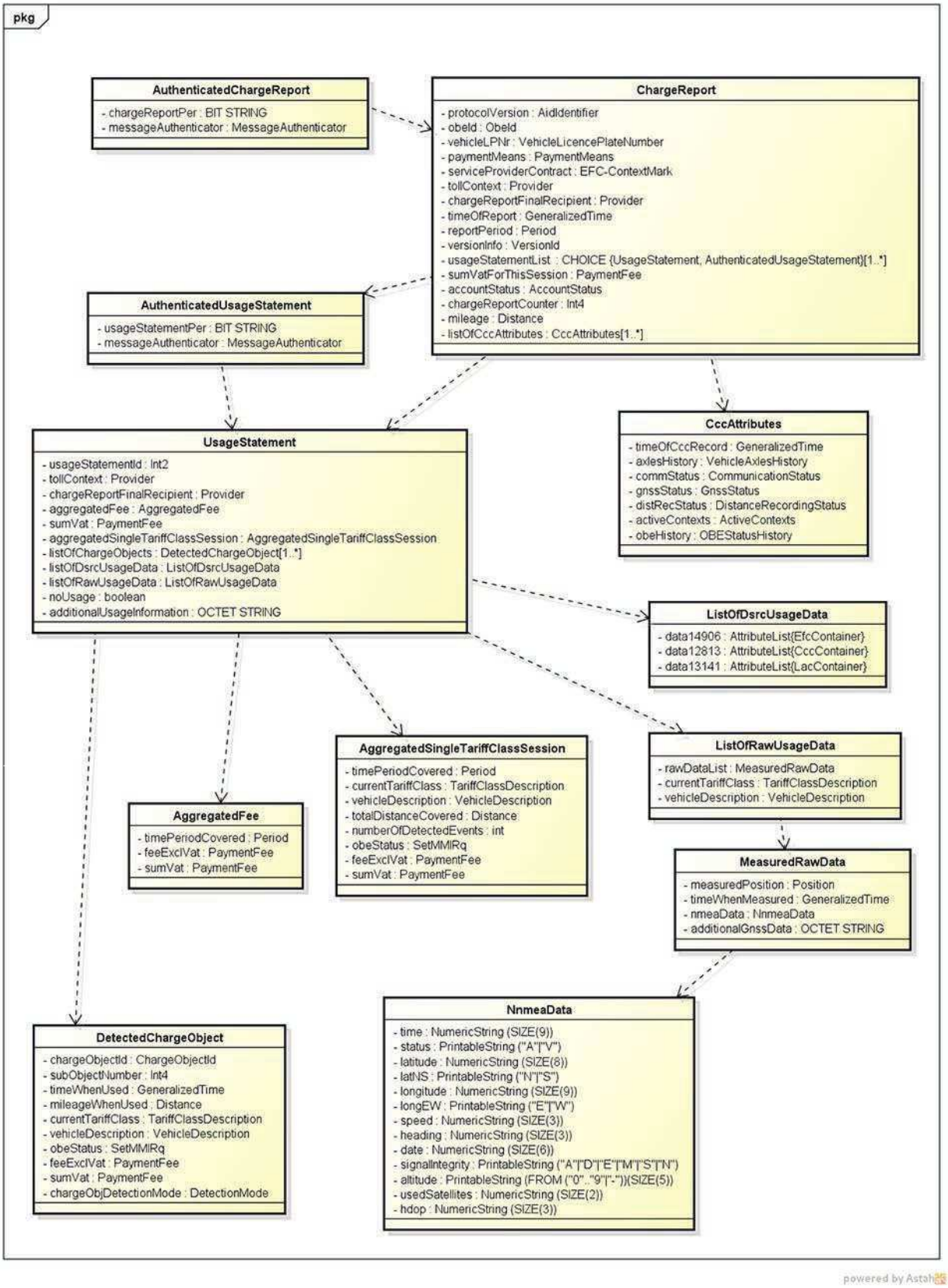

Figure C.1 — Hierarchy of data elements for charge report

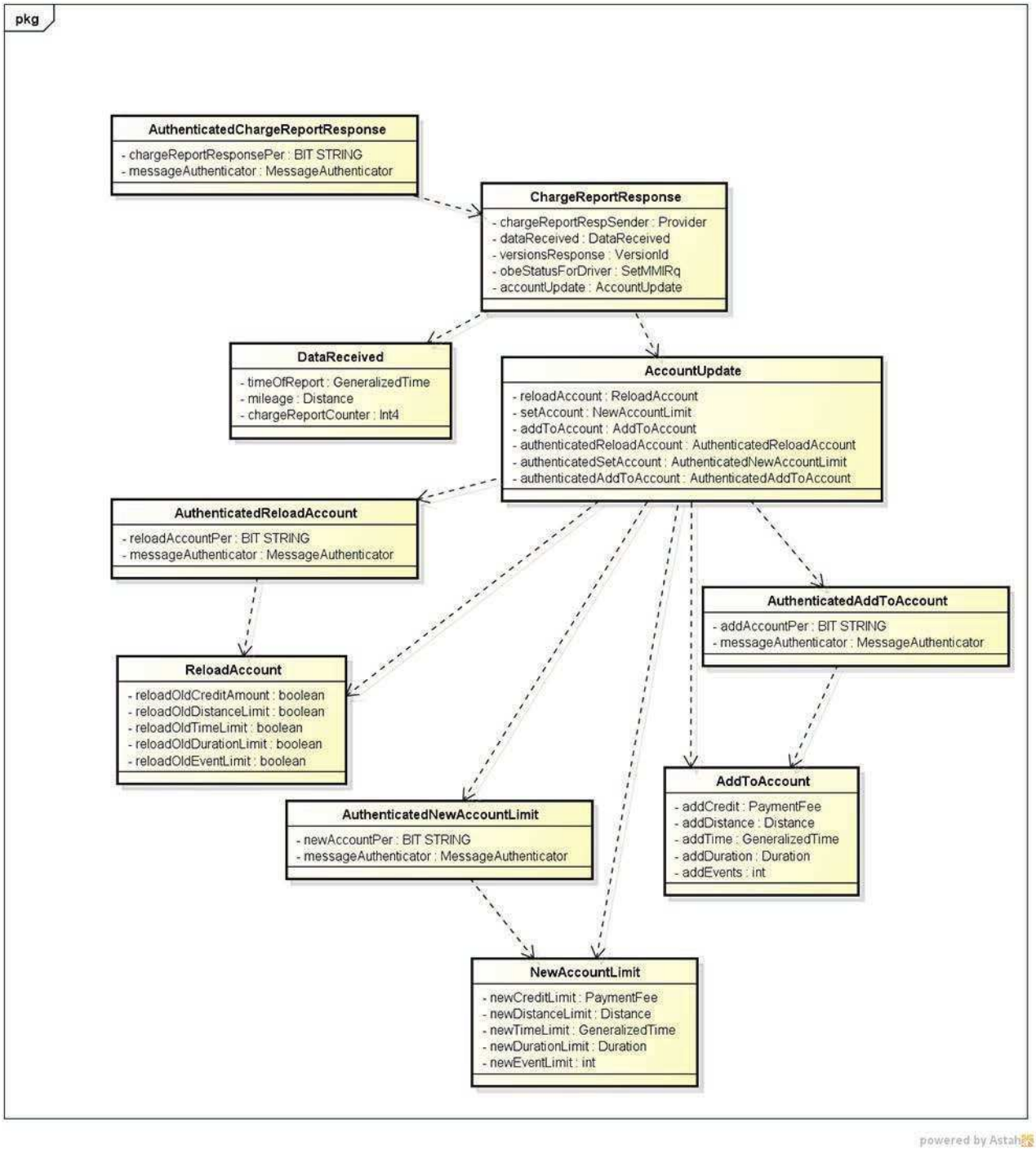

Figure C.2 — Hierarchy of data elements for charge report response

Annex D
(informative)

Use of this part of ISO 17575 for the EETS

D.1 General

In 2004, EU Directive 2004/52/EC of the European parliament and of the council "on the interoperability of electronic road toll systems in the community" was adopted. This EU Directive calls for the establishment of a European Electronic Toll Service (EETS).

In 2009, EC Decision 2009/750/EC "on the definition of the European Electronic Toll Service and its technical elements" was adopted. It set out the necessary technical specifications and requirements for that purpose, and contractual rules relating to EETS provision. The decision lays down rights and obligations on EETS providers, toll chargers and EETS users.

Other requirements and other EU Directives may also be applicable to the product(s) falling within the scope of this part of ISO 17575.

D.2 Overall relationship between European standardization and the EETS

EU Directive 2004/52/EC also triggered the establishment of a standardisation mandate (M/338, "Standardisation mandate to CEN, CENELEC and ETSI in support of Interoperability of electronic road toll systems in the Community") that called for development of technical standards in support of the EETS. Activities under M/338 are supervised by the "ITS co-ordination group" (ITS-CG, previously ICTSB/ITSSG).

M/338 does not explicitly call for the provision of harmonized standards (according to Directive 98/34/EC on the new approach to technical harmonization and standards), which means that this possibility is not available for the European standards that are developed in support of the EETS. Instead, this brief annex provides an outline of how this part of ISO 17575 could be used in the context of the EETS.

EC decisions can point out the use of specific standards, even if they are not formally harmonized. This is also done in EC Decision 2009/750/EC for a few standards (i.e. those that were available at the time of its approval). In case there will be more EC decisions in support of the EC directive, further European standards could be referenced there as well.

The European Commission has also published, in 2011, a "Guide for the Application of Directive on the Interoperability of Electronic Road Toll Systems" (ISBN 978-92-79-18637-0). This guide is intended to be a reference manual for all parties directly or indirectly concerned by Directive 2004/52/EC and Decision 2009/750/EC. It aims at providing help for the implementation of the EETS, including a list of standards that might be of use. The guide is only informative (e.g. the document cannot notify certain standards as "mandatory" for use in the EETS) and is intended to be updated on regular basis.

D.3 European standardization work supporting the EETS

Many of the standards developed by CEN/TC 278 have been drafted with the EETS requirements in mind (including the use of the results from European projects such as CARDME, PISTA, CESARE and RCI). CEN representatives have also taken part as observers in working groups, etc., initiated by the EC for the EETS. Hence, some work has been done in close co-operation between CEN working groups and the EC.

It should be noted that no CEN/ISO standards are "turnkey" solutions for the EETS. They are to be used as "building blocks" for the EETS, supporting the EETS legal framework and agreements between

the parties concerned by the EETS. A precise EETS specification is not within the scope of CEN/ISO standards, but remains the task of the owners of the EETS scheme.

It should also be noted that CEN/ISO has a wider scope than the EETS, which is a complementary service to the national services of the Member States and optional for the users, whereas CEN/ISO standards should be applicable to all EFC services worldwide.

D.4 Correspondence between this part of ISO 17575 and the EETS

This part of ISO 17575 defines requirements for the interface between a Front End and the Back End of a toll service provider. Since both sides of the interface are within the domain of the toll service provider, it is not a specification supporting interoperability directly. The main intention is to facilitate an open market for Front End technology.

This said, the data elements defined in this part of ISO 17575 are referenced in the standard ISO 12855:2015, which is of crucial importance for achieving interoperability between the toll service provider and the toll charger. In ISO 12855:2015, the data type `ChargeReport` is the core element of all toll declarations.

For the European context, this part of ISO 17575 is a toolbox intended to offer a set of optional data elements to support all autonomous toll schemes currently in operation or reasonably probable in the near future of electronic tolling.

This part of ISO 17575 defines requirements that correspond to requirements stated in EC Decision 2009/750/EC as listed in Table D.1

Table D.1 — ISO 17575-1 and EC Decision 2009/750/EC

Clause(s)/sub-clause(s) of ISO 17575-1	**Essential requirements of EC Decision 2009/750/EC**	**Qualifying remarks/Notes**
5.2, Clause 6, Annex A	Article 4.1	Flexibility of charge reports enables support of all EETS domains
Clause 6, Annex A	Annex III, Clause 1.5	Several provisions, such as authenticators, version info, transaction counters, etc., support this requirement
Clause 6, Annex A	Annex III, Clause 2.1.1.3	Data structures are referenced in ISO 12855:2015, therefore ISO 17575-1 supports interoperable communication.
Clause 6, Annex A	Annex III, Clause 2.1.1.6	Data structures are referenced in ISO 12855:2015, therefore this open standard ought to be applied in EETS.
7.6.7, Annex A	Annex VI, Clause 2	ISO 17575-1 offers a comprehensive set of parameters, imported from ISO 14906, for vehicle classification.

Bibliography

[1] ISO/IEC 8824-4, *Information technology — Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications — Part 4*

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

[3] ISO 12855:2015, *Electronic fee collection — Information exchange between service provision and toll charging*

[4] ISO 17575-2:2016, *Electronic fee collection — Application interface definition for autonomous systems — Part 2: Communication and connection to the lower layers*

[5] CEN/TS 16331:2012, *Electronic fee collection — Interoperable application profiles for autonomous systems*

[6] NMEA 0183 Interface Standard Version 4.10, National Marine Electronics Association

[7] ASME Y14.5:2009, *Dimensioning and Tolerancing*

[8] Directive 2004/52/EC of the European Parliament and of the Council of 29 April 2004 on the interoperability of electronic road toll systems in the Community. OJ L. 2004, **166** pp. 124–143

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[10] EC – DG for mobility and transport. Guide for the application of the directive on the interoperability of electronic road toll systems, ISBN 978-92-18637-0, 2011

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