
**Electronic fee collection — Application
interface definition for dedicated short-
range communication**

*Perception du télépéage — Définition de l'interface d'application relative
aux communications dédiées à courte portée*

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 14906 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*, in collaboration with Technical Committee CEN/TC 278, *Road transport and traffic telematics*.

This second edition cancels and replaces the first edition (ISO 14906:2004), which has been technically revised.

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Introduction

This International Standard specifies an application interface for electronic fee collection (EFC) systems, which are based on dedicated short-range communication (DSRC). It supports interoperability between EFC systems on an EFC-DSRC application interface level. This International Standard is intended for DSRC charging applications, but specifically the definition of EFC data elements is valid beyond the use of a DSRC charging interface and might be used for other DSRC applications (e.g. compliance checking communication) and/or on other interfaces (e.g. the application interface of autonomous systems).

This International Standard provides specifications for the EFC transaction model, EFC data elements (referred to as attributes) and functions, from which an EFC transaction can be built. The EFC transaction model provides a mechanism that allows handling of different versions of EFC transactions and associated contracts. A certain EFC transaction supports a certain set of EFC attributes and EFC functions as defined in this International Standard. It is not envisaged that the complete set of EFC attributes and functions be present in each piece of EFC equipment, on-board equipment (OBE) or roadside equipment (RSE).

This International Standard provides the basis for agreements between operators, which are needed to achieve interoperability. Based on the tools specified in this International Standard, interoperability can be reached by operators recognising each others' EFC transactions (including the exchange of security algorithms and keys) and implementing the EFC transactions in each others' RSEs, or they can reach an agreement to define a new transaction (and contract) that is common to both. Considerations should also be made by each operator so that the RSE has sufficient resources to implement such additional EFC transactions.

In order to achieve interoperability, operators should agree on issues such as

- which optional features are actually being implemented and used,
- access rights and ownership of EFC application data in the OBE,
- security policy (including encryption algorithms and key management, if applicable),
- operational issues, such as how many receipts may be stored for privacy reasons, how many receipts are necessary for operational reasons (for example as entry tickets or as proof of payment),
- the agreements needed between operators in order to regulate the handling of different EFC transactions.

In this revision, users are faced with issues related to backward compatibility. This issue can be managed by using the following:

- EfcModule ASN.1 module, including a version number;
- Efc-ContextMark (incl. the ContextVersion), denoting the implementation version, provides a means to ensure co-existence of different implementation versions by means of a look-up table and associated appropriate transaction processing. This will enable the software of the RSE to determine the version of the OBE and his capability to accept the new features of this version of this International Standard.

Annex A provides the normative ASN.1 specifications of the used data types (EFC action parameters and attributes).

Annex B presents an informative example of a transaction based on the CARDME specification, including bit-level specification.

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Annex C presents informative examples of EFC transaction types, using the specified EFC functions and attributes.

Annex D presents an informative listing of functional requirements, which can be satisfied by using the tools provided by this International Standard.

Annex E presents an informative mapping table from LatinAlphabetNo2 & 5 to LatinAlphabetNo1 to ease for a Service Provider the use of LatinAlphabetNo1 to encode an OBE for data available written with non-Latin1 characters.

Annex F presents an informative mapping table between EFC vehicle data attributes and European registration certificates to ease the task of a service provider when he needs to personalise an OBE by obtaining vehicle data.

This application interface definition can also be used with other DSRC media which do not use a layer 7 according to ISO 15628/EN 12834. Any DSRC medium which provides services to read and write data, to initialise communication and to perform actions is suitable to be used as a basis for this application interface. Adaptations are medium specific and are not further covered here. As Annex B describes in detail a transaction for central account systems, this International Standard can also be used for onboard account systems, in conjunction with ISO/TS 25110, which provides examples of systems based on onboard accounts.

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Electronic fee collection — Application interface definition for dedicated short-range communication

1 Scope

This International Standard specifies the application interface in the context of electronic fee collection (EFC) systems using the dedicated short-range communication (DSRC).

The EFC application interface is the EFC application process interface to the DSRC application layer, as can be seen in Figure 1 below. This International Standard comprises specifications of

- EFC attributes (i.e. EFC application information) that can also be used for other applications and/or interfaces,
- the addressing procedures of EFC attributes and (hardware) components (e.g. ICC and MMI),
- EFC application functions, i.e. further qualification of actions by definitions of the concerned services, assignment of associated ActionType values and content and meaning of action parameters,
- the EFC transaction model, which defines the common elements and steps of any EFC transaction,
- the behaviour of the interface so as to ensure interoperability on an EFC-DSRC application interface level.

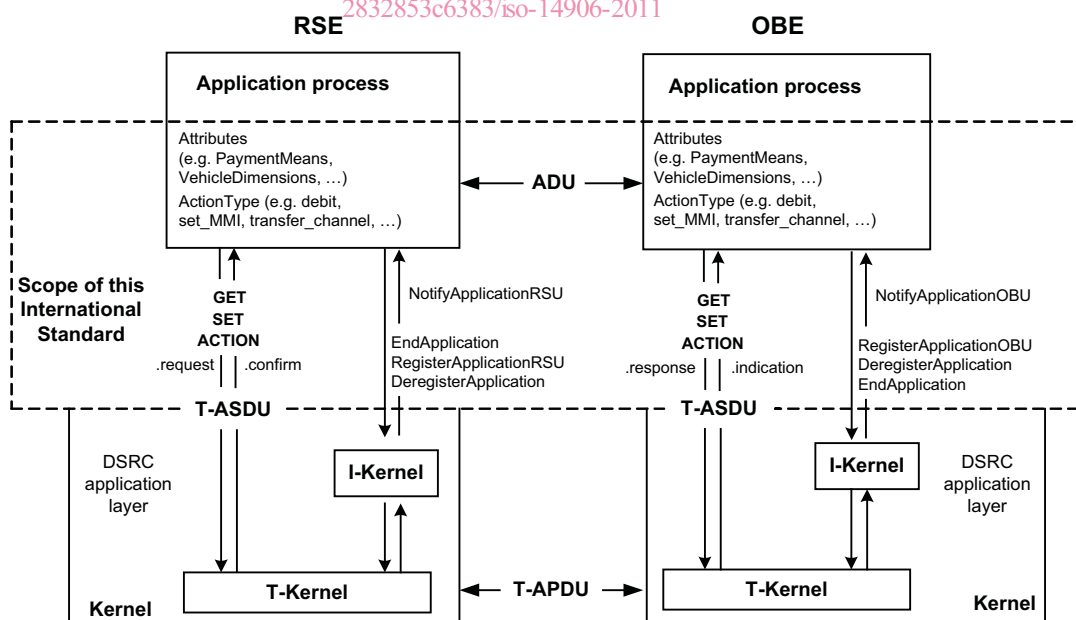


Figure 1 — The EFC application interface

This is an interface standard, adhering to the open systems interconnection (OSI) philosophy (see ISO/IEC 7498-1), and it is as such not concerned with the implementation choices to be realised at either side of the interface.

This International Standard provides security-specific functionality as place holders (data and functions) to enable the implementation of secure EFC transactions. Yet the specification of the security policy (including specific security algorithms and key management) remains at the discretion and under the control of the EFC operator, and hence is outside the scope of this International Standard.

2 Normative references

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

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

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

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 3779, *Road vehicles — Vehicle identification number (VIN) — Content and structure*

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

ISO 7812-1, *Identification cards — Identification of issuers — Part 1: Numbering system*

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)*

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ISO 14816:2005, *Road transport and traffic telematics — Automatic vehicle and equipment identification — Numbering and data structure*

ISO 15628:2007, *Road transport and traffic telematics — Dedicated short range communication (DSRC) — DSRC application layer*

EN 12834:2003, *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — DSRC application layer*

3 Terms and definitions

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

3.1 access credentials
data that is transferred to on-board equipment (OBE), in order to establish the claimed identity of a roadside equipment (RSE) application process entity

NOTE The access credentials carry information needed to fulfil access conditions in order to perform the operation on the addressed element in the OBE. The access credentials can carry passwords as well as cryptographic based information such as authenticators.

3.2 action
function that an application process resident at the roadside equipment can invoke in order to make the on-board equipment (OBE) execute a specific operation during the transaction

3.3**attribute**

application information formed by one or by a sequence of data elements, and that is managed by different actions used for implementation of a transaction

3.4**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

3.5**channel**

information transfer path

[ISO 7498-2:1989, definition 3.3.13]

3.6**component**

logical and physical entity composing an on-board equipment, supporting a specific functionality

3.7**contract**

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

3.8**cryptography**

discipline which embodies principles, means, and methods for the transformation of data in order to hide its information content, prevent its undetected modification and/or prevent its unauthorised use

[ISO 7498-2:1989, definition 3.3.20]

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3.9**data group**

collection of closely related EFC data attributes which together describe a distinct part of an EFC transaction

3.10**data integrity**

property that data has not been altered or destroyed in an unauthorised manner

[ISO 7498-2:1989, definition 3.3.21]

3.11**element**

⟨DSRC⟩ directory containing application information in the form of attributes

3.12**empty list**

container for attributeValues (OCTET STRING) with the length equal to zero

3.13**on-board equipment**

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.

3.14**on-board unit**

minimum component of an on-board equipment, whose functionality always includes at least the support of the DSRC interface

**3.15
operator**

entity involved in the process outside the user

NOTE An operator is a generic term which can be used for a toll service provider or a toll charger.

**3.16
roadside equipment**

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

**3.17
service**

〈EFC〉 road transport related facility provided by a service provider, normally a type of infrastructure, the use of which is offered to the user, for which the user may be requested to pay

**3.18
service primitive**

〈communication〉 elementary communication service provided by the application layer protocol to the application processes

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

**3.19
session**

exchange of information and interaction occurring at a specific EFC station between the roadside equipment and the user/vehicle

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**3.20
toll charger**

legal entity charging toll for vehicles in a toll domain

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[ISO/TS 17574:2009, definition 3.27]

**3.21
toll domain**

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

[ISO 17573:2010, definition 3.18]

**3.22
toll service**

〈EFC〉 service enabling users having only one contract and one set of on-board equipment (OBE) to use a vehicle in one or more toll domains

NOTE Adapted from ISO/TS 12813:2009.

**3.23
toll service provider**

〈EFC〉 legal entity providing to his customers toll services on one or more toll domains for one or more classes of vehicle

NOTE 1 In other documents the terms issuer or contract issuer may be used.

NOTE 2 The toll service provider may provide the OBE or may provide only a magnetic card or a smart card to be used with OBE provided by a third party (like a mobile telephone and a SIM card can be obtained from different parties).

NOTE 3 The toll service provider is responsible for the operation (functioning) of the OBE.

[ISO/TS 17574:2009, definition 3.28]

3.24**transaction**

whole of the exchange of information between the roadside equipment and the on-board equipment necessary for the completion of an EFC operation over the DSRC

3.25**transaction model**

functional model describing the general structure of electronic payment fee collection transactions

3.26**user**

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

4 Abbreviated terms

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

4.1**APDU**

Application Protocol Data Unit

4.2**AP**

Application Process

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4.3**ASN.1**

Abstract Syntax Notation One (ISO/IEC 8824-1) 14906:2011

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4.4**BST**

Beacon Service Table

4.5**CCC**

Compliance check communication

4.6**cf**

Confirm

4.7**DSRC**

Dedicated Short-Range communication

4.8**EID**

Element Identifier

4.9**EFC**

Electronic Fee Collection

4.10**GPS**

Global Positioning System

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4.11

ICC

Integrated Circuit(s) Card

4.12

I-Kernel

Initialisation Kernel

4.13

IID

Invoker Identifier

4.14

ind

Indication

4.15

LAC

Localisation Augmentation Communication

4.16

L1

Layer 1 of DSRC (Physical Layer)

4.17

L2

Layer 2 of DSRC (Data Link Layer)

4.18

L7

Application Layer Core of DSRC

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4.19

LID

Logical Link Control Identifier

4.20

LLC

Logical Link Control

4.21

LPDU

LLC Protocol Data Unit

4.22

MAC

Medium Access Control

4.23

MMI

Man-Machine Interface

4.24

n.a.

Not applicable

4.25

OBE

On-Board Equipment

4.26**PDU**

Protocol Data Unit

4.27**PER**

Packed Encoding Rules (ISO/IEC 8825-2)

4.28**req**

Request

4.29**rs**

Response

4.30**RSE**

Roadside Equipment

4.31**RTTT**

Road Transport and Traffic Telematics

4.32**SAM**

Secure Application Module

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4.33**T-APDU**

Transfer-Application Protocol Data Unit

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Transfer-Application Service Data Unit

4.35**T-Kernel**

Transfer Kernel

4.36**VST**

Vehicle Service Table

5 EFC application interface architecture**5.1 Relation to the DSRC communication architecture**

The DSRC services are provided to an application process by means of the DSRC Application Layer service primitives, which are abstract implementation interactions between a communication service user and a provider. The services are offered by the DSRC communication entities by means of its DSRC Application Layer (EN 12834/ISO 15628).

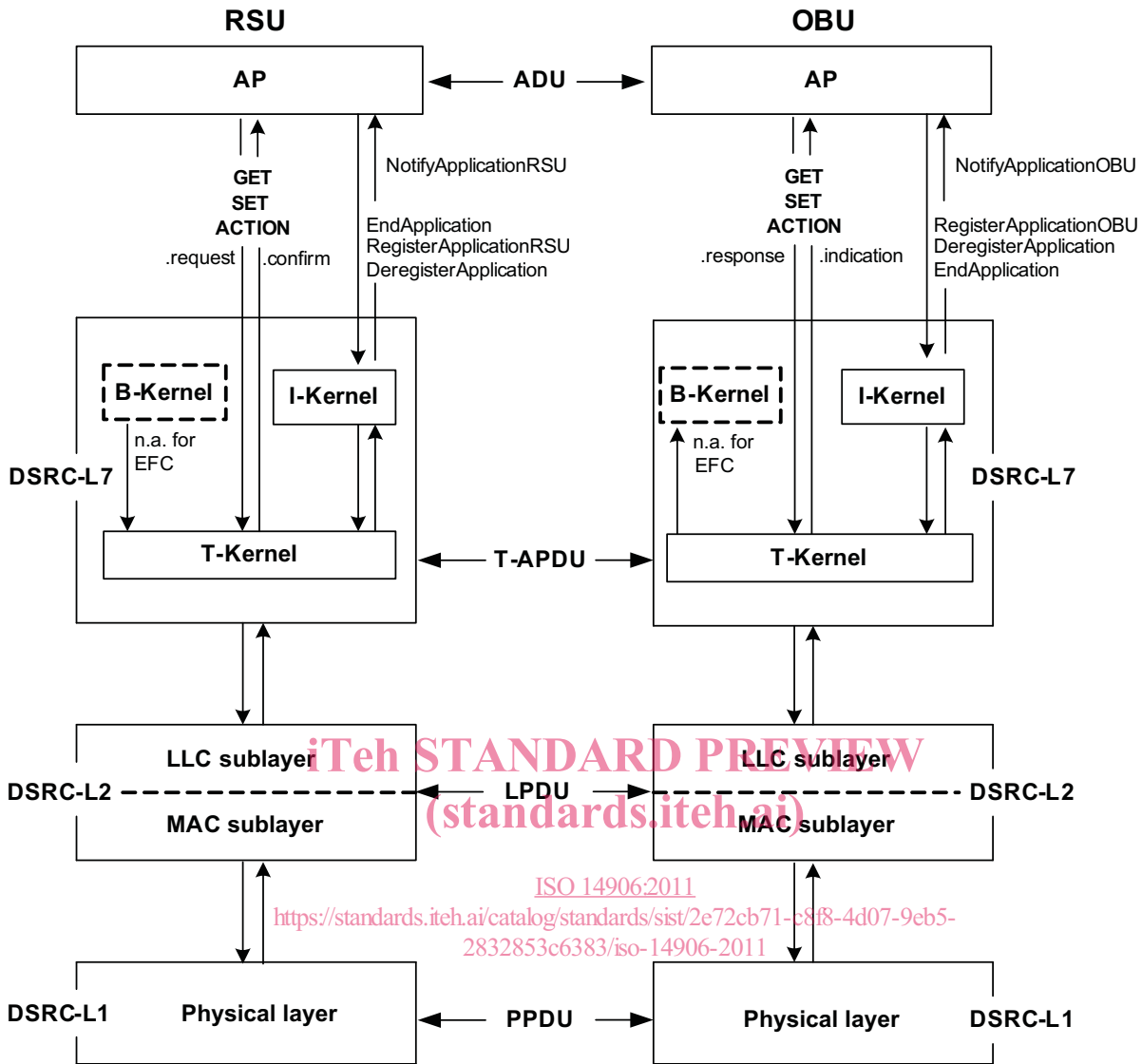


Figure 2 — The EFC application process on top of the DSRC communication stack

NOTE The abbreviations used in Figure 2 are defined in Clause 4.

The Transfer Kernel of DSRC Application Layer offers the following services to application processes (see also Figure 2 above):

- GET: The invocation of a GET service request results in retrieval (i.e. reading) of application information (i.e. Attributes) from the peer service user (i.e. the OBE application process), a reply is always expected.
- SET: The invocation of a SET service request results in modification (i.e. writing) of application information (i.e. Attributes) of the peer service user (i.e. the OBE application process). This service may be requested in confirmed or non-confirmed mode, a reply is only expected in the former case.
- ACTION: The invocation of an ACTION service request results in a performance of an action by the peer service user (i.e. the OBE application process). An action is further qualified by the value of the ActionType. This service may be requested in confirmed or non-confirmed mode, a reply is only expected in the former case.

- EVENT-REPORT: The invocation of an EVENT-REPORT service request forwards a notification of an event to the peer service user.
- INITIALISATION: The invocation of an initialisation service request by RSE results in an attempt to initialise communication between a RSE and each OBE that has not yet established communication with the concerned RSE. The Initialisation service is only used by the Initialisation Kernel as defined in EN 12834/ISO 15628.

5.2 Usage of DSRC application layer by the EFC application interface

EFC uses the following services offered by DSRC Application Layer (as defined in EN 12834/ISO 15628):

- The INITIALISATION services:
 - Notify Application RSU (at RSE);
 - End Application (at RSE);
 - Register Application RSU (at RSE);
 - Deregister Application (at RSE and OBE);
 - Notify Application OBU (at OBE);
 - Register Application OBU (at OBE);

are used to realise the EFC-specific initialisation mechanism (see Clause 6);
- The GET service is used to retrieve EFC attributes. (For attribute specifications see Clause 8);
- The SET service is used to set EFC attributes;
- The ACTION services are applied to realise additional EFC specific functionality needed to support EFC application processes, such as TRANSFER_CHANNEL, SET_MMI and ECHO (see 7.2).

In the following, the EFC-specific usage of the DSRC Layer 7 services is specified in detail.

NOTE The EVENT-REPORT-service can be implicitly used by EFC application processes. It is e.g. used indirectly as part of an already defined command to release an application process (see EN 12834/ISO 15628, Ready Application). However as the EVENT-REPORT-service is not explicitly used by EFC application processes, this service is not further referred to in this International Standard.

5.3 Addressing of EFC attributes

5.3.1 Basic mechanism

EFC Attributes are used to transfer the EFC application-specific information.

EFC Attributes are composed of one or more data elements of specified ASN.1 types. Each data element is associated with, within the context of this International Standard, an unambiguous name.

To each EFC Attribute, an AttributeID is associated. The AttributeID enables to unambiguously identify and address an EFC Attribute.