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Electronic fee collection — Localisation augmentation communication for autonomous systems

Perception de télépéage — Communications d'augmentation de localisations pour systèmes autonomes

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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 first edition replaces ISO/TS 13141:2010, which has been technically revised. It also incorporates ISO/TS 13141:2010/Cor1:2013. This first edition incorporates the following main modifications compared to the previous Technical Specification:

- conversion from a Technical Specification to an International Standard;
- generalized container definition;
- amendments to reflect changes to the underlying base standards;
- addition of a new informative annex (i.e. Annex G) on how to use this International Standard for the European electronic toll service;
- editorial and formal corrections as well as changes to improve readability.

Introduction

On-board equipment (OBE) that uses satellite-based positioning technology to collect data required for charging for the use of roads operates in a so-called autonomous way (i.e. generally without relying on dedicated roadside infrastructure). However, these autonomous systems can, in particular places, need some roadside infrastructure support for proper identification of charge objects. Such assistance might be required at places where satellite-based localization accuracy or availability is insufficient or at places where the OBE is directly informed about the identity of the relevant charge object.

In an interoperable environment, it is essential that this localization information be available in a standardized way. This International Standard defines requirements for localization augmentation by dedicated short-range communication (DSRC) between roadside equipment and on-board equipment. This International Standard makes no assumptions about the operator of the roadside equipment (RSE), in terms of his role according to ISO 17573, i.e. whether the RSE is operated by an entity in the service provision role or in the toll charging role.

This International Standard has been prepared considering the following requirements:

— the localization augmentation communication (LAC) serves to transmit localization information to passing OBE without identifying individual OBE;

— the localization information contains both geographical location independent of charging context, and context-dependent identification of charge objects;

— a single roadside installation is able to provide localization augmentation for several overlapping EFC contexts;

— this International Standard is based on the EFC architecture specified in ISO 17573;

— the communication applies to all OBE architectures;

— this International Standard is applicable to various DSRC media, especially the CEN DSRC stack;

— the communication supports security services for data origin authentication, integrity and non-repudiation.

This International Standard defines an attribute, LACData, which is communicated from the RSE to the OBE by means of an acknowledged writing service, which is implemented through the SET service of DSRC Layer 7 (ISO 15628 and EN 12834). The LAC application is defined as a self-contained DSRC application with its own application identifier (AID). Regarding the DSRC communications stack, this International Standard gives definitions for the CEN DSRC stack, as used in EN 15509 and Annexes C, D and E demonstrate, respectively, the use of ISO CALM IR, the use of Italian DSRC as specified in ETSI/ES 200674-1 and ARIB DSRC.

All data relevant for the LAC application have been put into the attribute LACData, in order to create a single standard communications content transmitted by LAC RSE, and always signed as a whole. LACData can transport both geographic coordinates (latitude, longitude and altitude) and the identification of a specific charge object. All elements of LACData are mandatory, but Null values are defined to allow LAC installations to transmit only a selection of all defined data elements.

Access credentials are mandatory for writing LACData in order to protect OBE from non-authentic RSE. LACData are critical for charge determination and for providing evidence. For these purposes, the authenticators which are defined can be used to provide for data origin authentication, data integrity and non-repudiation for LACData. There are two separate authenticator fields defined to allow for separate authentication and non-repudiation, if required by the institutional arrangements of a toll system.

This International Standard is “minimalist” in the sense that it covers what is required by operational systems and systems planned in the foreseeable future.

A test suite for checking an OBE or RSE implementation for compliance with the ISO/TS 13141 is defined in the corresponding edition of ISO/TS 13140-1 and ISO/TS 13140-2. This test suite is currently being updated to reflect the changes incorporated into this first edition of ISO 13141.

Electronic fee collection — Localisation augmentation communication for autonomous systems

1 Scope

This International Standard establishes requirements for short-range communication for the purposes of augmenting the localization in autonomous electronic fee collection (EFC) systems. Localization augmentation serves to inform on-board equipment (OBE) about geographical location and the identification of a charge object. This International Standard specifies the provision of location and heading information and security means to protect from the manipulation of the OBE with false roadside equipment (RSE).

The localization augmentation communication takes place between an OBE in a vehicle and fixed roadside equipment. This International Standard is applicable to OBE in an autonomous mode of operation.

This International Standard defines attributes and functions for the purpose of localization augmentation, by making use of the dedicated short-range communications (DSRC) communication services provided by DSRC Layer 7, and makes these LAC attributes and functions available to the LAC applications at the RSE and the OBE. Attributes and functions are defined on the level of Application Data Units (ADUs, see Figure 1).

As depicted in Figure 1, this International Standard is applicable to:

— the application interface definition between OBE and RSE;

— the interface to the DSRC application layer, as specified in ISO 15628 and EN 12834;

— the use of the DSRC stack.

The localization augmentation communication is suitable for a range of short-range communication media. This International Standard gives specific definitions regarding the CEN DSRC stack as specified in EN 15509, and Annexes C, D and E give the use of the Italian DSRC as specified in ETSI/ES 200 674-1, ISO CALM IR, and ARIB DSRC.

This International Standard contains a protocol implementation conformance statement (PICS) proforma in Annex B and informative transaction examples in Annex F. The informative Annex G highlights how to use this International Standard for the European electronic toll service (as defined in Commission Decision 2009/750/EC).

Test specifications are not within the scope of this International Standard.

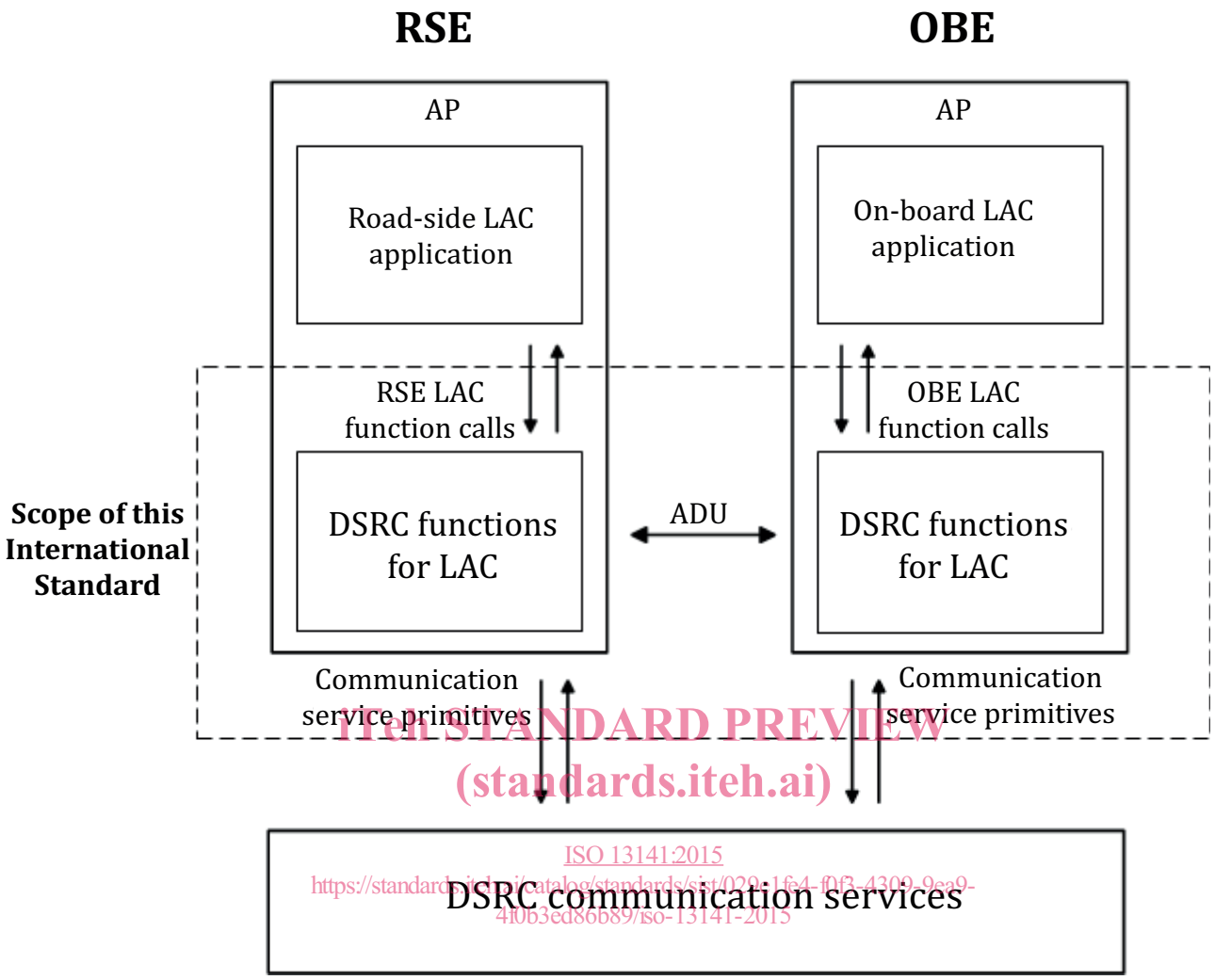

Figure 1 — The LAC application interface

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/IEC 8824-1:2008, *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 9797-1:2011, *Information technology — Security techniques — Message Authentication Codes (MACs) — Part 1: Mechanisms using a block cipher*

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

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

ISO 15628:2013, *Intelligent transport systems — Dedicated short range communication (DSRC) — DSRC application layer*

ISO 17575-1:2015,[1)] *Electronic fee collection — Application interface definition for autonomous systems — Part 1: Charging*

ISO/IEC 18033-3:2010, *Information technology — Security techniques — Encryption algorithms — Part 3: Block ciphers*

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

EN 15509:2014, *Electronic fee collection — Interoperability application profile for DSRC*

NIMA Technical Report TR8350.2 version 3, *Department of Defense World Geodetic System 1984, Its Definition and Relationships With Local Geodetic Systems*

3 Terms and definitions

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

3.1
access credentials
trusted attestation or secure module that establishes the claimed identity of an object or application

[SOURCE: EN 15509:2014, 3.1]

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

3.3
authentication
security mechanism allowing verification of the provided identity

[SOURCE: EN 301 175]

3.4
authenticator
data, possibly encrypted, that is used for authentication

[SOURCE: ISO/TS 19299:2015, 3.5]

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

3.6
data integrity
property that data has not been altered or destroyed in an unauthorized manner

[SOURCE: ISO/TS 19299:2015, 3.28]

3.7
on-board equipment
OBE
Note 1 to entry: all required equipment on-board a vehicle for performing required EFC functions and communication services

1) To be published.

3.8
roadside equipment
RSE
equipment located along the road, either fixed or mobile

3.9
service primitive
elementary communication service provided by the application layer protocol to the application processes

[SOURCE: ISO 14906:2011, 3.18 modified]

3.10
toll context
logical view as defined by attributes and functions of the basic elements of a toll scheme consisting of a single basic tolling principle, a spatial distribution of the charge objects and a single behaviour of the related Front End

3.11
transaction
whole of the exchange of information between two physically separated communication facilities

4 Abbreviated terms

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

ADU	Application data unit (ISO 14906)
AID	Application identifier (ISO 15628 and EN 12834)
ASN.1	Abstract syntax notation one (ISO/IEC 8824-1)
BST	Beacon service table (ISO 14906)
CCC	Compliance check communication (ISO 12813)
DSRC	Dedicated short-range communication (ISO 14906)
EID	Element identifier (ISO 15628 and EN 12834)
EFC	Electronic fee collection
IR	Infrared
IUT	Implementation under test
LAC	Localisation augmentation communication
MAC	Media Access control (EN 12795) or Message authentication code (ISO 14906)
OBE	On-board equipment (ISO 14906)
PICS	Protocol implementation conformance statement
RSE	Roadside equipment (ISO 14906)
VST	Vehicle service table (ISO 14906)
WGS84	World Geodetic System 1984

5 Application interface architecture

5.1 General

This clause gives an insight into the LAC architecture by identifying the functions, the use of DSRC communication primitives, and the attributes addressed. A detailed description of the functions is given in Clause 6, while details of the attributes are in Clause 7.

The LAC application interface has been designed to make use of the CEN DSRC communication stack, via the application layer as specified in ISO 15628 and EN 12834. For other identified DSRC communication media, detailed mappings to corresponding services are given in Annexes C, D and E.

5.2 Services provided

The LAC application interface offers the following services to LAC applications:

— writing of data in order for the RSE to communicate location data to the OBE;

— authentication of the RSE by the OBE by means of access credentials.

There is no read service provided within the LAC communication. The RSE transmits data to the OBE using the underlying acknowledged communication services, in order to verify that the data indeed are properly transmitted over the DSRC interface.

The above services are realized by means of protocol exchanges performed by means of communication services and transactions as described in Clause 8.

The services are provided by the following functions:

— the “Initialise communication” function, which shall be used to establish the LAC communication link between the RSE and OBE;

— the “Write data” function, which shall be used to send LAC attributes to the OBE;

— the “Terminate communication” function, which shall be used to terminate the LAC communication.

5.3 Attributes

There is a single attribute defined for localization augmentation. This attribute contains a set of data in order for the OBE to be able to determine its localization with better accuracy and availability or to directly receive a charge object identification related to the local toll context. This set of data contains:

— geographic coordinates (latitude, longitude and altitude);

— charge object reference.

When the RSE writes this attribute to the OBE, it shall transmit geographic coordinates or charge object reference or both.

5.4 Contract and toll context

Regarding LAC, the OBE shall identify itself in the initialisation phase with a single LAC Context Mark in the VST. This Context Mark identifies the user contract in terms of the service provider, type of contract and version information. This information enables the RSE to decide whether the OBE carries a contract which it supports, and if so, to choose the corresponding security elements.

An RSE can provide the OBE with localization augmentation for several overlapping contexts simultaneously by writing the LAC attribute (which includes the applicable toll context) several times in one transaction.

NOTE The LAC operates in a broadcast fashion, where the RSE has only minimal information about the OBE and is not able to assess the liability of a vehicle for tolls. For this reason, the OBE can receive LAC information which is not applicable.

5.5 Use of lower layers

5.5.1 Supported DSRC communication stacks

The LAC application interface makes use of the CEN DSRC communication stack as described in Table 1. Other communication media can be used as listed in Table 1 if an equivalent mapping to corresponding services is provided. Detailed examples are provided in Annexes C, D and E.

Table 1 — Supported short-range communication stacks

Medium	Application layer	Lower layers	Detailed specifications
CEN-DSRC	ISO 15628 and EN 12834	EN 12795 and EN 12253	Specification in 5.5.2
Italian DSRC	ES 200 674–1 (Clause 11 and Annex D)	ES 200 674–1 (Clauses 7 to 10 and Annex D)	Implementation example in Annex C
ISO CALM IR	ISO 15628 and EN 12834	ISO 21214	Implementation example in Annex D
ARIB DSRC	ARIB STD-T75 and ISO 15628	ARIB STD-T75 ITU-R. M1453–2	Implementation example in Annex E

NOTE EN 12795 and EN 12253 have been adopted in ITU-R.M 1453–2.

If more than one communication medium is implemented in an OBE, the OBE shall respond to RSE interrogations on the same medium as the RSE has used.

5.5.2 The use of the CEN DSRC stack

The LAC application shall be used with the CEN DSRC communication stack in the following ways:

— the OBE shall comply with EN 15509:2014, 6.1.2;

— the RSE shall comply with EN 15509:2014, 6.2.2.

NOTE Compliance with EN 15509 implies compliance of the DSRC stack with ISO 15628 and EN 12834 regarding the application layer, and EN 12795 and EN 12253 for the lower layers.

6 Conformance requirements

6.1 General

In the view of the OBE, the LAC communication is a read only data exchange. There is neither an interrogation of OBE capabilities nor feedback from the OBE regarding the received data or commands. From that this follows that the OBE shall support all standardized LAC RSE transaction sequences.

The RSE shall only broadcast, within the context of LAC transactions, attributes defined in this International Standard.

