International Standard

ISO 13141

Electronic fee collection — Localization augmentation communication for autonomous systems

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

Second edition
2024-02

Reference number
ISO 13141:2024(en)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Intelligent transport systems,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 13141:2015), which has been technically revised. It also incorporates the Amendment ISO 13141:2015/Amd. 1:2017.

The main changes are as follows:

— Clause 6 has been added, concerning conformance requirements;

— Clause 3 has been updated and ISO/TS 17573-2 has been made the primary source for terms and definitions;

— data definitions in Clause 8 have been updated, including making reference to ISO 17573-3 as the primary source;

— imported ASN.1 types with successors (i.e. including all future minor versions) have been used;

— Annex G has been revised to align with the evolution of the European Electronic Toll Service (EETS);[19],[20],[21]

— various editorial changes have been made to improve readability.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

On-board equipment (OBE) that uses satellite-based positioning technology to collect data required for charging for the use of roads operates in an "autonomous" way (i.e. generally without relying on dedicated roadside infrastructure). However, these autonomous systems can, in some places, need some roadside infrastructure support for proper identification of charge objects. Such assistance can 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 document specifies requirements for localization augmentation by dedicated short-range communication (DSRC) between roadside equipment (RSE) and OBE. This document makes no assumptions about the operator of the RSE in terms of its role according to ISO 17573-1, i.e. whether the RSE is operated by an entity in the service provision role or in the toll charging role.

This document has been prepared considering the following points.

— 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 electronic fee collection (EFC) contexts.

— This document is based on the EFC architecture specified in ISO 17573-1.

— The communication applies to all OBE architectures.

— This document 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 document specifies 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 specified as a self-contained DSRC application with its own application identifier (AID). Regarding the DSRC communications stack, this document provides specific definitions regarding the CEN DSRC stack as specified in EN 15509. Annexes C, D, E and H provide for use of the Italian DSRC as specified in ETSI/ES 200 674-1.[9] ISO CALM IR,[3] ARIB DSRC[10] and WAVE DSRC.[11]

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

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

This document is “minimalist” in the sense that it covers what is required for operational systems and planned systems.

A test suite for checking an OBE or RSE implementation for conformance with ISO 13141:2015 is specified in ISO 13140-1:2016. This test suite will be updated to reflect the changes incorporated into this second edition of ISO 13141.

Electronic fee collection — Localization augmentation communication for autonomous systems

1 Scope

This document 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 document specifies the provision of location and heading information and security means to protect against the manipulation of the OBE with false RSE.

The localization augmentation communication (LAC) takes place between an OBE in a vehicle and fixed RSE. This document is applicable to OBE in an autonomous mode of operation.

This document specifies 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 specified on the level of application data units (ADUs; see Figure 1).

As depicted in Figure 1, this document is applicable to:

— the application interface definition between OBE and RSE;

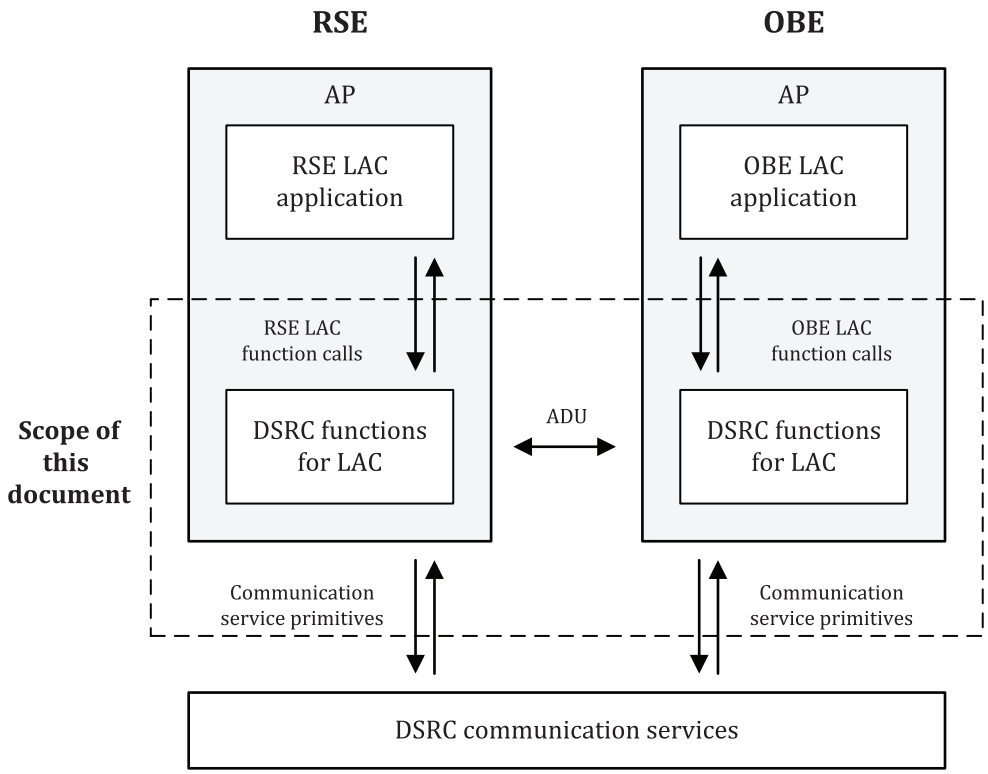
— the interface to the DSRC application layer, as specified in ISO 15628 and EN 12834;

— the use of the DSRC stack.

The LAC is suitable for a range of short-range communication media. This document provides specific definitions regarding the CEN-DSRC stack as specified in EN 15509. Annexes C, D, E and H provide for the use of the Italian DSRC as specified in ETSI/ES 200 674-1,[9] ISO CALM IR,[3] ARIB DSRC[10] and WAVE DSRC.[11]

This document contains a protocol implementation conformance statement (PICS) proforma in Annex B and transaction examples in Annex F. Annex G highlights how to use this document for the European Electronic Toll Service (EETS).

Test specifications are not within the scope of this document.



Key

AP	application process
ADU	application data unit
LAC	localization augmentation communication
OBE	on-board equipment
RSE	roadside equipment

Figure 1 — The LAC application interface

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

ISO 14906:2022, *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/IEC 18033-3:2010, *Information technology — Security techniques — Encryption algorithms — Part 3: Block ciphers*

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

EN 15509:2023, *Electronic fee collection — Interoperability application profile for DSRC*

ISO 17573-3:2023, *Electronic fee collection — System architecture for vehicle-related tolling — Part 3: Data dictionary*

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.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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

[SOURCE: ISO/TS 17573-2:2020, 3.4]

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

[SOURCE: ISO/TS 17573-2:2020, 3.13]

3.3
authentication
security mechanism allowing verification of the provided identity

[SOURCE: EN 301 175 V1.1.1:1998, 3]

3.4
authenticator
data, possibly encrypted, that is used for *authentication* (3.3)

[SOURCE: ISO/TS 17573-2:2020, 3.16]

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

[SOURCE: ISO/TS 17573-2:2020, 3.31]

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

[SOURCE: ISO 7498-2:1989, 3.3.21]

3.7
on-board equipment
all required equipment on-board a vehicle for performing required electronic fee collection (EFC) functions and communication services

[SOURCE: ISO/TS 17573-2:2020, 3.126]

3.8
roadside equipment
fixed or movable electronic fee collection (EFC) equipment located along or on the road

Note 1 to entry: Movable RSE can be mounted temporarily along the road or in a vehicle.

[SOURCE: ISO/TS 17573-2:2020, 3.161]

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

[SOURCE: ISO/TS 17573-2:2020, 3.173]

3.10
toll charger
entity which levies toll for the use of vehicles in a toll domain

[SOURCE: ISO/TS 17573-2:2020, 3.194]

3.11
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

[SOURCE: ISO/TS 17573-2:2020, 3.196]

3.12
toll service provider
entity providing toll services in one or more toll domains

[SOURCE: ISO/TS 17573-2:2020, 3.206]

3.13
transaction
whole of the exchange of information between two physically separated communication facilities

[SOURCE: ISO/TS 17573-2:2020, 3.211]

4 Abbreviated terms

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

AC-CR	access credentials
ADU	application data unit
AID	application identifier
ASN.1	abstract syntax notation one
BST	beacon service table
CCC	compliance check communication
DSRC	dedicated short-range communication
EID	Element identifier
EFC	electronic fee collection

ETRF	European terrestrial reference frames
IR	infrared
ITRF	international terrestrial reference frames
IUT	implementation under test
LAC	localization augmentation communication
MAC	message authentication code
OBE	on-board equipment
PICS	protocol implementation conformance statement
PSC	provider service context
RSE	roadside equipment
TC	toll charger
TSP	toll service provider
VST	vehicle service table
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 7, while details of the attributes are in Clause 8.

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, E and H.

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, to verify that the data are indeed 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 9.

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 specified for localization augmentation. This attribute contains a set of data which enables the OBE to determine its location 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);

— a charge object reference.

When the RSE sends data to the set [i.e. write value(s) of the addressed attribute(s)] in the OBE, it shall transmit geographic coordinates or a 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, E and H.

Table 1 — Supported short-range communication stacks

Medium	Application layer	Lower layers	Detailed specifications
CEN DSRC	ISO 15628 and EN 12834	EN 12795[a] and EN 12253[a]	Specification in 5.5.2
Italian DSRC	ES 200 674–1 (2013, Clause 11 and Annex D)[9]	ES 200 674–1 (2013, Clauses 7 to 10 and Annex D)[9]	Implementation example in Annex C
ISO CALM IR	ISO 15628 and EN 12834[a]	ISO 21214	Implementation example in Annex D
ARIB DSRC	ARIB STD-T75[10] and ISO 15628	ARIB STD-T75[10] ITU-R.M1453–2[23]	Implementation example in Annex E
WAVE DSRC	IEEE 1609.11[15] ISO 15628	IEEE 1609.3[13] IEEE 1609.4[14] IEEE 802.11[11]	Implementation example in Annex H

[a] EN 12795[24] and EN 12253[25] have been adopted in ITU-R.M 1453–2.[23]

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