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Intelligent transport systems (ITS) — Location referencing for geographic databases —

Part 4: Precise relative location references (precise relative profile)

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Contents

Page

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 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*.

A list of all parts in the ISO 17572 series can be found on the ISO website.

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

A Location Reference (LR) is a unique identification of a geographic object. In a digital world, a real-world geographic object can be represented by a feature in a geographic database. An example of a commonly known LR is a postal address of a house. Examples of object instances include a particular exit ramp on a particular motorway, a road junction or a hotel. For efficiency reasons, LRs are often coded. This is especially significant if the LR is used to define the location for information about various objects between different systems. For ITS, many different types of real-world objects will be addressed. Amongst these, the LR of the road network, or components thereof, is a particular focus.

Communication of a LR for specific geographic phenomena, corresponding to objects in geographic databases, in a standard, unambiguous manner is a vital part of an integrated ITS system in which different applications and sources of geographic data will be used. Location Referencing Methods (LRM), methods of referencing object instances, differ by applications, by the data model used to create the database, or by the enforced object referencing imposed by the specific mapping system used to create and store the database. A standard LRM allows for a common and unambiguous identification of object instances representing the same geographic phenomena in different geographic databases produced by different vendors, for varied applications, and operating on multiple hardware/software platforms. If ITS applications using digital map databases are to become widespread, data reference across various applications and systems must be possible. Information prepared on one system, such as traffic messages, need to have LRs that are interpretable by all receiving systems. A standard method to refer to specific object instances is essential to achieving such objectives.

Japanese, Korean, Australian, Canadian, North American and European ITS bodies all support LR activities . In Japan, precise location referencing is needed due to the increasing introduction of C-ITS and automated driving systems such as SIP-adus. Due to the mechanisms for the creation of digital maps, even with high accuracies, representation of a real-world position will differ between maps. Additionally, because of crustal movement over time, discrepancies would occur for locations determined simply by measurements from ground-based objects if only latitude and longitude were utilized.

Location referencing at the precise relative level is needed to describe exact positions and exchange LRs accordingly. Location referencing at the precise relative level requires referencing to a position that is sufficiently detailed and accurate to distinguish the lane in which the object exists, and to distinguish the position within a lane or a lane junction. This does not imply the need to provide an absolute position with a high accuracy.

This document provides specifications for location referencing for ITS systems (although other committees or standardization bodies may subsequently consider extending it to a more generic context).

Intelligent transport systems (ITS) — Location referencing for geographic databases —

Part 4: Precise relative location references (precise relative profile)

1 Scope

This document describes and lists the characteristics of the Precise Relative Location Referencing Method (PRLRM) which describes precise relative locations in the context of geographic databases and is used to locate transport-related objects in an encoder system as well as in the decoder side.

This document does not define a physical format for implementing the PRLRM. However, the requirements for physical formats are defined. This document does not define details of the Precise Relative Location Referencing System (PRLRS), i.e. how the PRLRM is to be implemented in software, hardware or processes.

This document specifies PRLRM, comprising:

— conceptual data model for Location Referencing Methods (LFMs);

— specification of location referencing for precise relative information;

— use cases for Precise Relative Location References (informative Annex C);

— use cases for elements of Precise Relative Location References (informative Annex D);

— implementation of Precise Relative Location References (Japanese example) (informative Annex E).

This document defines methods that enable exchange location information of the object to be referenced in the lane or the lane junction. This document does not specify the road (link) on which the object of reference exists.

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 17572-1:2015, *Intelligent transport systems (ITS) — Location referencing for geographic databases — Part 1: General requirements and conceptual model*

ISO 17572-2:2018, *Intelligent transport systems (ITS) — Location referencing for geographic databases — Part 2: Pre-coded location references (pre-coded profile)*

ISO 17572-3:2015, *Intelligent transport systems (ITS) — Location referencing for geographic databases — Part 3: Dynamic location references (dynamic profile)*

ISO 19148:2012, *Geographic information — Linear referencing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17572-1 and the following apply.

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

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

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

3.1
lane
strip of carriageway intended to accommodate a single line of moving vehicles, frequently defined by carriageway marks

3.2
lane junction
area of roadway common to two or more lanes, whether in the same or different directions, frequently without carriageway marks and where it may be difficult to count lanes

3.3
reference point
point which is used as a starting point for referencing

4 Abbreviated terms

C-ITS	Cooperative Intelligent Transport Systems
GNSS	Global Navigation Satellite System
ID	Identifier
LR	Location Referencing (or Reference)
LP	Location Point
LRM	Location Referencing Method
PRLRM	Precise Relative Location Referencing Method
PRLRS	Precise Relative Location Referencing System
SIP-adus	Cross-ministerial Strategic Innovation Promotion Program Innovation of Automated Driving for Universal Services (Japan)

5 Conformance

A location referencing message shall be provided as specified in Clause 8.

Any location referencing message claiming conformance with this document shall pass the requirements presented in the abstract test suite in Annex A.

6 Requirements for a location referencing standard

For details, see ISO 17572-1:2015, Clause 4.

NOTE For an inventory of LRMs, see ISO 17572-1:2015, Annex A.

Additional requirements for this document are defined as follows.

— A Precise Relative Location Reference shall have a sufficiently high accuracy to distinguish the lane, or the position within/close to the intersection, in which the referenced object exists.

— A Precise Relative Location Reference shall support the definition of 3-dimension positional information.

— A Precise Relative Location Reference shall not wholly be reliant on geographic coordinates.

  Due to the mechanisms for the creation of digital maps, even with high accuracy, a coordinate representation of a real-world position can differ between maps. Additionally, there is a(n) (Earth's) crustal movement of 20 cm/year in some points in Japan, for example, so there may be discrepancies between the true location determined in real-time with a high-accurate GNSS and the location on a map created in the past.

— A reference point shall be defined to reference within an intersection.

  Because there is no lane information within an intersection, a reference point which is used as a basis for reference shall be defined.

— A road section shall have a direction.

  In order to distinguish the left and right sides of the lanes, a road section shall have a direction.

7 Conceptual data model for LFMs

7.1 Role of conceptual model

See ISO 17572-1:2015, 5.1.

7.2 Components of conceptual model

See ISO 17572-1:2015, 5.2.

7.3 Description of the conceptual model

See ISO 17572-1:2015, 5.3.

7.4 Location categories

General location categories for LR are defined in ISO 17572-1:2015, 5.4.

Locations for precise relative location reference shall be categorized as point locations, linear locations, area locations, and solid volume locations. These location categories represent real world objects which can be described as follows:

— a single position (point location);

— between two points in the same lane (linear location);

— between two points in different lanes (linear location);

— between two points with no lane-specific definition (linear location);

— a bounded area on the same lane (area location);

— a bounded area on different lanes (area location);

— a bounded area with no lane-specific definition (area location);

— an object position (solid volume location).

7.5 Conceptual model of a road network

One purpose of PRLRS is to be able to locate an object on a road within a specific lane. For this reason, this subclause expands on the conceptual model of a road network described in ISO 17572-1:2015, 5.5 and adds the concept of a lane. The conceptual model of the road network is, therefore, depicted in Figure 1 and described in this subclause to give a clear understanding of the different terms and their relationships. The definition of each word is described in ISO 17572-1:2015, Clause 2 and Clause 4. Figure 1 shows the conceptual model of a road network.

In general, the road network consists of roads and intersections. A road is generally identified by a name (or number) and consists of a set of road sections. A road element consists of one or more lanes. On a road, a very large (but countable) number of road segments can be defined (and referenced). A road section consists of nodes and edges, is bounded by intersections, and can have intermediate intersections (where the road name does not change, for example). An intersection is a connection or crossing of roads. The simplest intersection consists of just one node (i.e. junction). The data model of a lane may be formed with the addition of location referencing related items to the lane model of ISO 14296. A basic lane model is shown in Annex B.

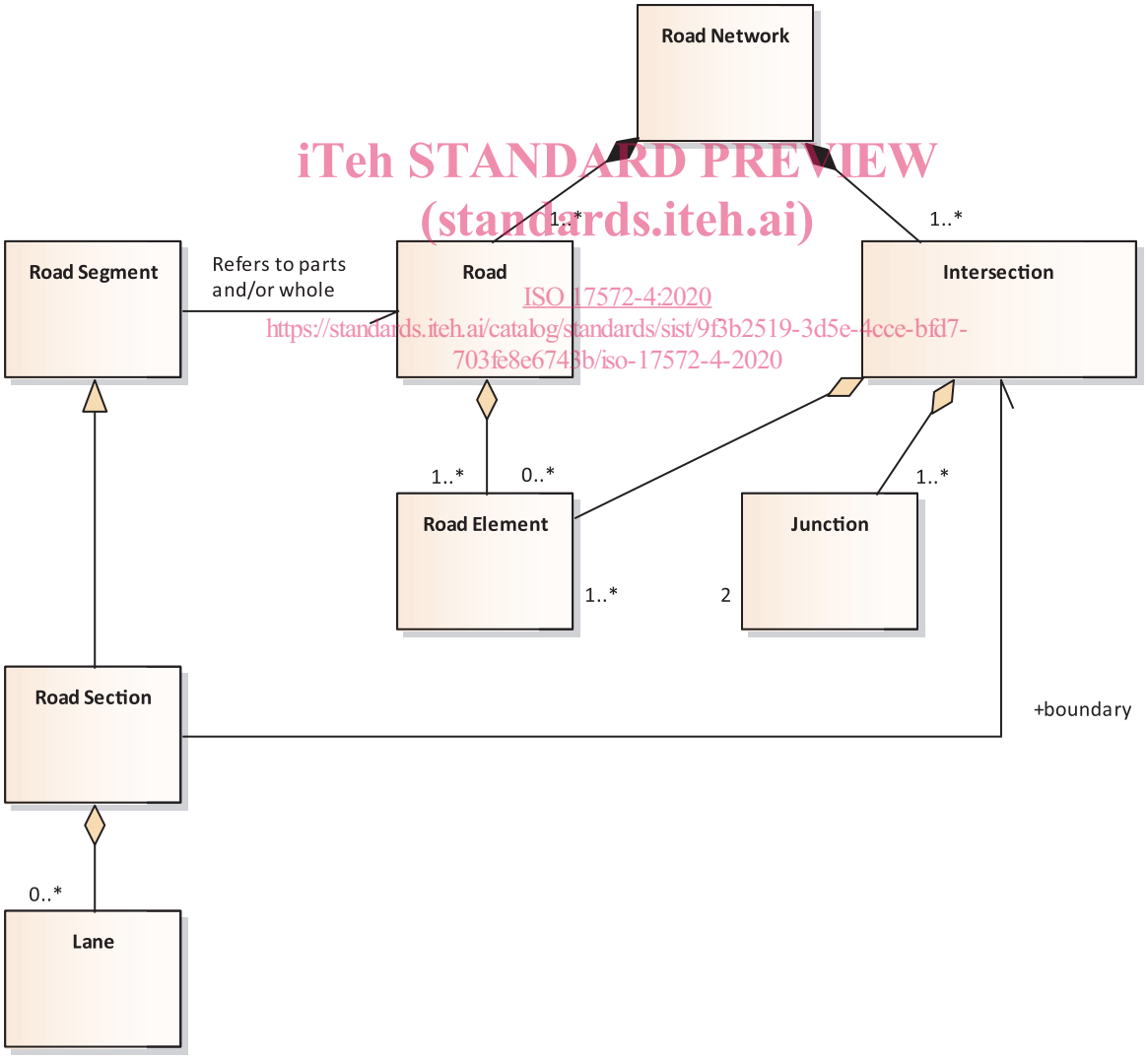

Figure 1 — Conceptual model for the physical road network

7.6 Conceptual model of area locations

See ISO 17572-1:2015, 5.6.

8 Specification of LRs for precise relative information

8.1 General concept

8.1.1 Methods to be defined in this document

The methods to be defined in this document are being adopted for Precise Relative Location References which allows for location referencing within lanes as defined in 7.5.

There are two ways to reference a location using this method:

— (Method 1) Lane number counting;

— (Method 2) Displacement from a reference point.

Either method is selected by road segment type and/or usage. As a general rule, Method 1 is used to represent events in lanes (excluding an intersection) and Method 2 is used to represent events in a junction. However, Method 2 can also be used to represent events in lanes.

This document defines how to express the representative point of each object. It does not explain how to express the real shape of line, area and solid volume.

Figure 2 shows the two methods for PRLRM.

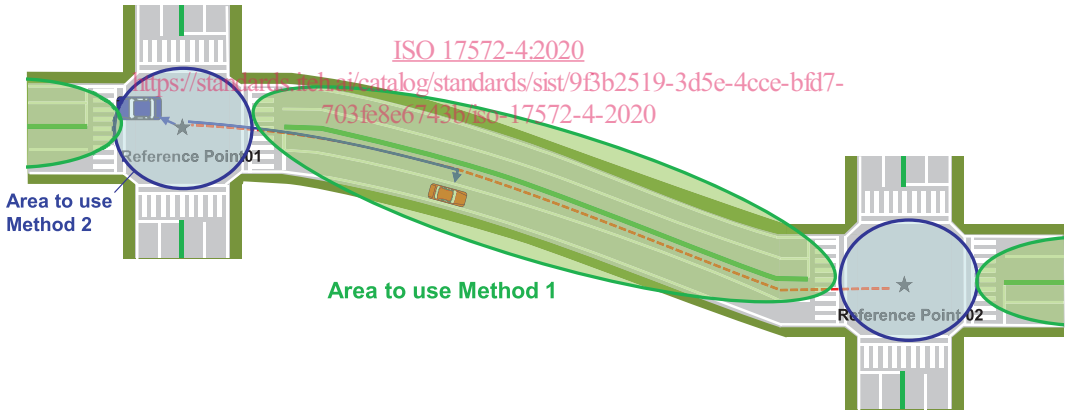

Figure 2 — Methods for PRLRM

8.1.2 Concept of Method 1: Lane number counting

8.1.2.1 General concept of Method 1

The linearly referenced location shall be referenced by using a distance on a road section and lane number counting rule. The distance on a road section references the longitudinal location on a road and the lane number references the lateral location. The distance on a road section may be expressed as a percentage along the road section or a distance from a start point. The expression shall be consistent with the definition defined in ISO 19148:2012, 6.2. The vertical location shall be expressed as a relative height from the road surface. The expression shall be consistent with the definition provided in ISO 19148:2012, 6.2.

This method is used for:

— road segments that have lane information;

— specifying the lane.

Figure 3 demonstrates Method 1.

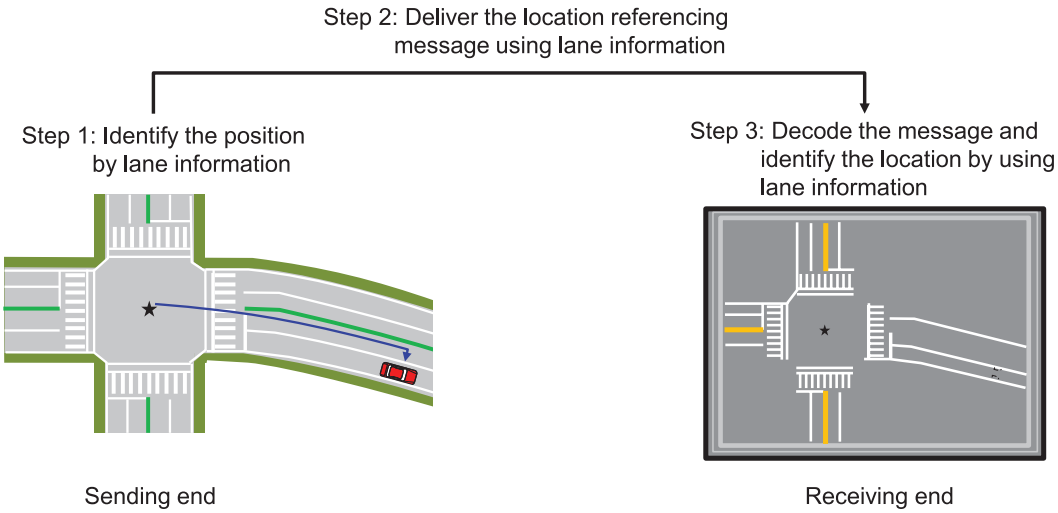

Figure 3 — Explanation of Method 1

8.1.2.2 Procedure to use Method 1

The sender of the location information sends the objective road section, distance from start point, and object lane for the objective location.

A method provided by ISO17572-2:2018 or ISO 17572-3:2015 shall be used to identify the objective road section. Use the ID in ISO 17572-2:2018, Clause 7 to identify the objective road section. To define the location of a LP, use ISO 17572-3:2015, 7.2.2.

The start point shall be shared by the sender and the receiver. The start point may be set at any location within the road section and any location on roadway.

Object lane includes lane counting convention, total number of lanes, object lane number, and specific lane flag. Specific lane flag is used when the targeting object exists on a specific lane, e.g. specialty lanes and road shoulders, e.g. bus lanes and emergency parking areas.

The receiver of the location information identifies the road section on its own map from the objective road section received and the location of the sender from the percentage along distance from start point, lane counting convention, total number of lanes, object lane number, and specific lane flag.

8.1.3 Concept of Method 2: Displacement from a reference point

8.1.3.1 General concept of Method 2

The location shall be referenced by using the distance from a reference point (dx, dy, dh). The X axis represents east/west and the Y axis represents north/south. The H axis represents the height.

This method is used for:

— the road segments of lane junctions;

— specifying the relative position within a road (e.g. $\sigma < 25$ cm accuracy).

