INTERNATIONAL STANDARD

ISO 17572-1

Third edition
2022-07

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

Part 1: General requirements and conceptual model

Systèmes de transport intelligents (ITS) — Localisation pour bases de données géographiques —

Partie 1: Exigences générales et modèle conceptuel

Reference number
ISO 17572-1:2022(E)

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Published in Switzerland

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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*.

This third edition cancels and replaces second edition (ISO 17572-1:2015), which has been technically revised.

The main changes are as follows:

— Annex C has been significantly reduced;

— Annex D, Annex E and Annex F have been deleted;

— cross-references have been updated throughout the document to refer to the most recent edition of the relevant publication;

— various minor editorial modifications have been made throughout.

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.

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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 location reference 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, location references are often coded. This is especially significant if the location reference is used to define the location for information about various objects between different systems. For intelligent transport systems (ITS), many different types of real-world objects are addressed. Amongst these, location referencing of the road network, or components thereof, is a particular focus.

Communication of a location reference for specific geographic phenomena, corresponding to objects in geographic databases, in a standardized, unambiguous manner is a vital part of an integrated ITS system in which different applications and sources of geographic data are 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 standardized location referencing method 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, it is necessary for data referencing across various applications to be possible. Information prepared on one system, such as traffic messages, needs to be interpretable by all receiving systems. A standardized method to refer to specific object instances is essential in achieving such objectives.

LR activities are currently supported by Japanese, Korean, Australian, Canadian, US and European ITS bodies. Japan has developed a link specification for vehicle information and communication systems (VICS). In Europe, the radio data system – traffic message channel (RDS-TMC) traffic messaging system has been developed. In addition, methods have been developed and refined in the EVIDENCE and AGORA projects based on intersections identified by geographic coordinates and other intersection descriptors. In the US, standards for location referencing have been developed to accommodate several different location referencing methods.

This document provides specifications for location referencing for ITS systems (although other committees or standardization bodies can subsequently consider extending it to a more generic context). Other LR methods for transport protocol experts group (TPEG) and geographic information are defined in the following documents:

— ISO/TS 21219-21, *Intelligent transport systems — Traffic and travel information via transport protocol experts group, generation 2 (TPEG2) — Part 21: Geographic location referencing (TPEG-GLR)*

— ISO/TS 21219-22, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 22: OpenLR location referencing (TPEG2-OLR)*

— ISO 19148, *Geographic information — Linear referencing*

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

Part 1: General requirements and conceptual model

1 Scope

The ISO 17572 series specifies location referencing methods (LRMs) that describe locations in the context of geographic databases and that are intended for use in locating transport-related phenomena both in an encoder system and from the decoder side. This document defines what is meant by such objects and describes the reference in detail, including whether or not components of the reference are mandatory or optional, and their characteristics.

The ISO 17572 series specifies three different LRMs:

— pre-coded LRM (pre-coded profile);

— dynamic LRM (dynamic profile);

— precise relative LRM (precise relative profile).

The ISO 17572 series does not define a physical format for implementing the LRM. However, the requirements for physical formats are defined.

The ISO 17572 series does not define details of the location referencing system (LRS), i.e. how the LRMs are to be implemented in software, hardware or processes.

This document specifies the following general LRM-related subjects:

— requirements of an LRM;

— conceptual data model for LRMs;

— inventory LRMs (see Annex A).

This document also provides:

— examples of conceptual model use (see Annex B);

— a comparison of definitions with ISO/TC 211 (see Annex C).

2 Normative references

There are no normative references in this document.

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/

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3.1
accuracy
measure of closeness of results of observations, computations, or estimates to the true values or the values accepted as being true

3.2
area
two-dimensional, geographical region on the surface of the Earth

Note 1 to entry: An area can be represented as an implicit area or an explicit area.

3.3
area location
two-dimensional location, representing a geographical region on the surface of the Earth

3.4
attribute
characteristic property of a real-world feature

Note 1 to entry: This property allows the identification of a specific feature by its attributes. An attribute has a defined type and contains a value. Attributes can be either simple, consisting of one atomic value, or composite (see composite attribute).

3.5
coordinate
one of an ordered set of *N* numbers designating the position of a point in *N*-dimensional space

Note 1 to entry: *N* would be 1, 2 or 3.

3.6
complex intersection
intersection that consists at least of two or more junctions and one or more road elements

3.7
datum
parameter or set of parameters that realize the position of the origin, the scale, and the orientation of a coordinate system

[SOURCE: ISO 19111:2019, 3.1.15, modified — admitted term ("reference frame") removed.]

3.8
descriptor
characteristic of a geographic object, usually stored as an attribute

EXAMPLE Road names or road numbers.

3.9
digital map database
structured set of digital and alphanumeric data portraying geographic locations and relationships of spatial features

Note 1 to entry: Typically, such structures represent, but are not limited to, the digital form of hard copy maps. For example, drawings can be imported into a geographic information system (GIS) and considered as a form of digital map.

3.10
dynamic location reference
location reference generated on-the-fly based on geographic properties in a digital map database

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3.11
explicit area
two-dimensional face on the surface of the earth, with a specified outline either being a simple geometric figure or an irregular outline/polygon

3.12
geodetic reference frame
reference frame or datum describing the relationship of a two- or three-dimensional coordinate system to the Earth

[SOURCE: ISO 19111:2019, 3.1.34, modified — Note 1 to entry has been removed.]

3.13
implicit area
selection of road segments to be referenced belonging to a certain area (subnetwork)

Note 1 to entry: One implicit area can be built up of multiple subnetworks that are geographically connected.

3.14
international terrestrial reference frame
ITRF
Earth-centred global reference frame, including an Earth model, based on satellite and terrestrial data; realization of the international terrestrial reference system (ITRS)

Note 1 to entry: The ITRF is a realization of the international terrestrial reference system (ITRS). It contains primary parameters defining the shape, angular velocity and the earth mass of an Earth ellipsoid, and secondary parameters defining a gravity model of the Earth. Primary parameters are used to derive latitude-longitude coordinates (horizontal datum). The ITRF94 reference frame is defined in ISO 19161-1.

3.15
international terrestrial reference system
ITRS
reference system for the Earth derived from precise and accurate space geodesy measurements, not restricted to GNSS Doppler measurements, which is periodically tracked and revised by the International Earth Rotation and Reference Service

Note 1 to entry: The basic information and the requirements related to the ITRS are defined in ISO 19161-1.

3.16
intersection
<ITS> crossing and/or connection of two or more roads

Note 1 to entry: In the ISO 20524 series (Geographic Data Files, GDF), an intersection is a level 2 representation of a junction which bounds a road or a ferry. It is a complex feature, composed of one or more level 1 junctions, road elements and enclosed traffic areas. The definition in this document is different from that of the ISO 20524 series because the location referencing system refers to real-world objects rather than a database definition, as defined in the ISO 20524 series.

Note 2 to entry: Crossings can be at-grade or grade-separated. Crossings that are grade-separated where no connection between the road segments exists are excluded from this definition.

3.17
road junction
junction
elementary element in the road network, connecting two or more road elements

Note 1 to entry: In the ISO 20524 series (Geographic Data Files, GDF), a junction is a level 1 feature that bounds a road element or ferry connection. Junctions that represent real crossings are at least trivalent (having three roads connected). A bivalent junction can only be defined if an attribute change occurs along the road (e.g. road name change). A junction is also coded at the end of a dead-end road, to terminate it.

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3.18
linear location
location that has a one-dimensional character

EXAMPLE A road segment.

3.19
link
edge
<ITS> direct topological connection between two nodes that has a unique link ID in a given digital map database

Note 1 to entry: A link can contain additional intermediate coordinates (shape points) to better represent the shape of curved features. A link can be directed or undirected.

3.20
link identifier
link ID
identifier that is uniquely assigned to a link

Note 1 to entry: A link identifier can be arbitrary or can be assigned by convention to ensure that no multiple occurrences of the same identifier will be used within one instance of a network or map database.

3.21
link location
location identifiable by a part of the road network database having one identifier or having a uniquely identifiable combination of attributes throughout the continuous stretch

Note 1 to entry: One link location can consist of multiple links.

3.22
location
particular place or position

Note 1 to entry: A location is matched to database objects by location definitions, which specify what is meant by a particular location. Without any explicit remark, it is intended to be a linear stretch in terms of topology in the database network without any loops or discontinuities in between (linear location). It can also be only a point in the network as a specialization of a linear stretch with length zero. In addition to that, a location can also be a set of road elements representing an area. This area is expressible by a polygon or a list of linear locations. For further description of different categories of locations, refer to 6.4.

[SOURCE: ISO 19112:2019, 3.1.3, modified — The original Note to entry and Example have been removed. A new Note 1 to entry has been added.]

3.23
location reference
LR
label assigned to a location

Note 1 to entry: With a single location referencing method (LRM), one reference defines unambiguously and exactly one location in the location referencing system as defined in 5.2. The location reference is the string of data which is passed between different implementations of a location referencing system to identify the location.

3.24
location definition
actual delineation of exactly what is meant, and therefore what is not meant, by a particular location within a specific database

Note 1 to entry: It is the precise location definition of the database object, or set of database objects, which is referenced.

EXAMPLE GDF road elements that make up a particular instance of an ALERT-C location.

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3.25
location referencing
action to assign a label to a location

3.26
location referencing method
LRM
methodology of assigning location references to locations

3.27
location referencing system
LRS
complete system by which location references are generated, according to a location referencing method, and communicated, including standards, definitions, software, hardware, and databases

3.28
matching
<ITS> translation of a location reference to a specific object in a given map database to attempt recognition of the same identified object in both the sender's and the receiver's map database

Note 1 to entry: Matching is seen as a subsequent part to the method of decoding a location reference adhering to the defined LRM.

3.29
node
zero-dimensional element that is a topological junction of two or more edges or an end point of an edge

Note 1 to entry: A node is created for topologically significant points, such as simple intersections of roads or other linear features including boundaries, but also for locations such as electric beacons, kilometre-posts, or sensors detecting traffic flows, these being significant points specified in a map.

3.30
point
zero-dimensional element that specifies geometric location

Note 1 to entry: One coordinate pair or triplet specifies the location.

3.31
point location
location with a zero-dimensional character

EXAMPLE A simple crossing.

3.32
precision
closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same or similar objects

Note 1 to entry: Alternatively, the closeness of measurements of the same phenomenon repeated under exactly the same conditions and using the same techniques.

[SOURCE: ISO/IEC Guide 99:2007, 2.15, modified — The Note to entry and Example have been removed. A new Note 1 to entry has been added.]

3.33
pre-coded location reference
location reference using a unique identifier that is agreed upon in both a sender and receiver system to select a location from a set of pre-coded locations

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3.34
quad tree
hierarchical data structure which, on a next lower level, subdivides a given area into four quadrants of the same size where any level has knowledge of its four sublevels and its parent level

3.35
relationship
<ITS> semantic or topological interrelation or dependency between locations in the location referencing system (LRS)

Note 1 to entry: Relationships can exist between locations in the LRS. These relationships will generally be structured to allow more sophisticated use of the location reference, such as a topological or hierarchical structure. For example, a county location can be defined as an aggregate of several city locations or a long stretch of road can be an aggregate of several smaller road segments. Referencing the county can be easier than referencing all the cities which make up the county. This allows scalability and ease of use in the LRSs using the location referencing method (LRM).

Note 2 to entry: The term definition in ISO/TC 211 is different because of the difference in conceptual level between the groups.

3.36
road
part of the road network which is generally considered as a whole and which can be addressed by a single identification like a road name or road number throughout

Note 1 to entry: In general, it is a connection within the road network, with or without crossings, which functionally can be considered as a unity. A road with multiple (associated) carriageways can be considered as one road. Within the ISO 17572 series, the term also covers the natural language term "street".

Note 2 to entry: The subsequent parts of this document intentionally do not make direct use of this term because under different circumstances it is not always possible to define exactly where a road ends. For this reason, reference is made to artificial but more precisely-definable road elements or road sections of the road network.

3.37
road crossing
location where two or more roads connect or intersect

Note 1 to entry: A road crossing can be “simple”, corresponding to one junction, or “complex”, including internal road elements and junctions.

3.38
road element
linear section of the road network which is designed for vehicular movement having a junction at each end

Note 1 to entry: It serves as the smallest unit of the road network at GDF level 1 that is independent.

3.39
road section
road segment that is bounded by two intersections and has the same attributes throughout

Note 1 to entry: Generally, the two intersections are different, only in some specific cases are the intersections the same, e.g. a tear-drop street or slip roads inside of complex intersections.

3.40
road segment
part of a road, having its start and end along that road

Note 1 to entry: An important difference between a road section and road segment is that the segment does not necessarily end at intersections.

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3.41
shape point
intermediate coordinate pair to represent the shape of curved features

3.42
subnetwork
plurality of road segments lying in geographical or topological conjunction to each other

3.43
topology
properties of spatial configuration invariant under continuous transformation

Note 1 to entry: In a digital map database, this means the logical relationships among map features. It can be used to characterize spatial relationships such as connectivity and adjacency.

4 Abbreviated terms

AGORA	implementation of global location referencing approach (name of a European Union project 2000–2002)
ALERT-C	advice and problem location for European road traffic-compact
EVIDENCE	extensive validation of identification concepts in Europe (name of a European Union project 1998–1999)
GDF	geographic data file
GIS	geographic information system
GNSS	global navigation satellite system
ITS	intelligent transport systems
POI	point of interest
RDS	radio data system
TPEG	transport protocol expert group
TMC	traffic message channel
TTI	traffic and traveller information
UML	unified modelling language
UTM	universal transverse mercator
VICS	vehicle information and communication system

NOTE The ISO 17572 series uses unified modelling language (UML) to express specific circumstances. As such, graphical elements are used to express specific constraints and structural relationships. A full definition can be found in the ISO/IEC 19505 series.

5 Objectives and requirements for a location referencing method

5.1 Objectives for an optimal location referencing method

ITS applications have different objectives regarding location referencing, which from their contradictory nature, cannot be fulfilled completely. In theory, an ideal location referencing method would require every LRS to have at a given time the same, completely accurate map and all locations

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