INTERNATIONAL STANDARD

ISO 17572-1

First edition
2008-12-15

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

Part 1
General requirements and conceptual model

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

Partie 1: Exigences générales et modèle conceptuel

Reference number
ISO 17572-1:2008(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.

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 17572-1 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

ISO 17572 consists of the following parts, under the general title *Intelligent transport systems (ITS) — Location referencing for geographic databases*:

— *Part 1: General requirements and conceptual model*

— *Part 2: Pre-coded location references (pre-coded profile)*

— *Part 3: Dynamic location references (dynamic profile)*

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 will be 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 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 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, data reference across various applications and systems must be possible. Information prepared on one system, such as traffic messages, must be interpretable by all receiving systems. A standard method to refer to specific object instances is essential to achieving such objectives.

Japan, Korea, Australia, Canada, the US and European ITS bodies are all supporting activities of Location Referencing. Japan has developed a Link Specification for VICS. In Europe, the 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 International Standard provides specifications for location referencing for ITS systems (although other committees or standardization bodies may subsequently consider extending it to a more generic context). In addition, this edition does not deal with public transport location referencing; this issue will be dealt with in a later edition.

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

Part 1: General requirements and conceptual model

1 Scope

This International Standard specifies Location Referencing Methods (LRM) that describe locations in the context of geographic databases and will be used to locate transport-related phenomena in an encoder system as well as in the decoder side. This International Standard 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.

This International Standard specifies two different LRMs:

— pre-coded location references (pre-coded profile);

— dynamic location references (dynamic profile).

This International Standard does not define a physical format for implementing the LRM. However, the requirements for physical formats are defined.

This International Standard 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 part of ISO 17572 specifies the following general LRM related sections:

— requirements of a Location Referencing Method;

— conceptual Data Model for Location Referencing Methods;

— inventory of Location Referencing Methods;

— examples of Conceptual Data Model Use;

— description of selected UML Elements;

— comparison of Definitions with ISO/TC 211;

— introduction to the TPEG Physical Format.

It is consistent with other International Standards developed by ISO/TC 204 such as ISO 14825, *Intelligent transport systems — Geographic Data Files (GDF) — Overall data specification*.

2 Terms and definitions

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

2.1 General terms [1)]

2.1.1
accuracy
measure of closeness of results of observations, computations or estimates to the true values or the values accepted as being true

2.1.2
area
two-dimensional, geographical region on the surface of the earth

NOTE An area can be represented as an implicit area or an explicit area.

2.1.3
area location
two-dimensional location, representing a geographical region on the surface of the earth

2.1.4
attribute
characteristic property of an entity like a real-world feature

NOTE It allows the identification of that feature by the sum of its attributes. An attribute has a defined type and contains a value. Attributes can be either simple, i.e. consisting of one atomic value, or composite (see composite attribute).

2.1.5
coordinate
one of an ordered set of N numbers designating the position of a point in N-dimensional space

2.1.6
complex intersection
intersection that consists at least of two or more junctions and one or more road elements

2.1.7
composite attribute
complex attribute
attribute consisting of two or more atomic values and/or attributes

2.1.8
datum
set of parameters and control points used to accurately define the three-dimensional shape of the earth

NOTE The corresponding datum is the basis for a planar coordinate reference system.

2.1.9
descriptor
characteristic of a geographic object, usually stored in an attribute

EXAMPLE Road names or road numbers.

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1) As part of the general intent to harmonize this International Standard with the ISO/TC 211 family of Geographic Information Systems standards, a comparison of terms and definitions between this International Standard and ISO/TC 211 standards is included as Annex D.

2.1.10
digital map database
structured set of digital and alphanumeric data portraying geographic locations and relationships of spatial features

NOTE Typically, such structures represent, but are not limited to, the digital form of hard copy maps. For example, drawings may be imported into a Geographic Information System (GIS) and considered as a form of digital map.

2.1.11
dynamic location reference
location reference generated on-the-fly based on geographic properties in a digital map database

2.1.12
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

2.1.13
face
two-dimensional element bounded by a closed sequence of edges not intersecting themselves

NOTE The face is the atomic two-dimensional element.

2.1.14
implicit area
selection of road segments to be referenced belonging to a certain area (subnetwork)

NOTE One implicit area can be built up of multiple subnetworks that are geographically connected.

2.1.15
international terrestrial reference frame
ITRF
realization of the ITRS

NOTE The ITRF94 reference frame is consistent with WGS84 at the 5 cm level, and therefore is equivalent to WGS84 for ITS applications.

2.1.16
international terrestrial reference system
ITRS
reference system for the earth derived from precise and accurate space geodesy measurements, not restricted to GPS Doppler measurements, which is periodically tracked and revised by the international earth rotation service

2.1.17
intersection
crossing and/or connection of two or more roads

NOTE 1 In 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 is different from GDF because the location referencing system refers to real-world objects rather than a database definition as defined in GDF.

NOTE 2 Crossings can be at-grade or grade-separated. Crossings that are grade-separated where no connection between the road segments exist, are excluded from this definition.

2.1.18
junction
elementary element in the road network, connecting two or more road elements

NOTE In GDF terms, it 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 may only be defined in case 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.

2.1.19
linear location
location that has a one-dimensional character

EXAMPLE A road segment.

2.1.20
link
edge
direct topological connection between two nodes that has a unique link id in a given digital map database

NOTE A link may contain additional intermediate coordinates (shape points) to better represent the shape of curved features. A link may be directed or undirected.

2.1.21
link identifier
link id
identifier that is uniquely assigned to a link

NOTE A link identifier may be arbitrary or may be assigned by convention, to assure that no multiple occurrences of the same identifier will be used within one instance of a network or map database.

2.1.22
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 One link location can consist of multiple links.

2.1.23
location
simple or compound geographic object to be referenced by a location reference

NOTE 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 meant to be a linear stretch in terms of topology in the database network without any loops or discontinuities in between (linear location). It might 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 e.g. expressible by a polygon or a list of linear locations. For further description of different categories of locations, refer to 5.4.

2.1.24
location definition
actual delineation of exactly what is meant (and, therefore, what is not meant) by a particular location within a specific database

NOTE It is the precise location definition of the database object, or set of database objects, which is referenced.

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

2.1.25
location reference
reference
label which is assigned to a location

NOTE With a single LRM, one reference shall define unambiguously and exactly one location in the location referencing system. The reference is the string of data which is passed between different implementations of a location referencing system to identify the location.

2.1.26
location referencing method
LRM
methodology of assigning location references to locations

2.1.27
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

2.1.28
matching
translating 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 Matching is seen as a subsequent part to the method of decoding a location reference adhering to the defined LRM.

2.1.29
node
zero-dimensional element that is a topological junction of two or more edges, or an end point of an edge

NOTE 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, being significant points specified in a map.

2.1.30
node identifier
identifier assigned to a node

NOTE A node identifier may be arbitrary, or may be assigned by convention, to ensure that multiple occurrences of the same identifier will not occur within one network or within the universe of similar networks or databases.

2.1.31
outlined area
explicit area with an outline defined by segments being either polylines or linear locations

2.1.32
point
zero-dimensional element that specifies geometric location

NOTE One coordinate pair or triplet specifies the location.

2.1.33
point location
location that has a zero-dimensional character

EXAMPLE A simple crossing.

2.1.34
precision
exactness of the measurement of a data value, or of the storage allocated to a measured data value

NOTE Alternatively, the closeness of measurements of the same phenomenon repeated under exactly the same conditions and using the same techniques.

2.1.35
pre-coded location reference
location reference using a unique identifier that is agreed upon in both sender and receiver system to select a location from a set of pre-coded locations

2.1.36
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

2.1.37
relationship
semantic or topological interrelation or dependency between locations in the LRS

NOTE 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 may be defined as an aggregate of several city locations or a long stretch of road may be an aggregate of several smaller road segments. Referencing the county may be easier than referencing all the cities which make up the county. This allows scalability and ease of use in the LRSs using the LRM.

2.1.38
resolution
smallest unit which can be represented fixing a limit to precision and accuracy

2.1.39
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 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. (Note that, in the context of this part of ISO 17572, the term also covers the natural language term street).

NOTE 2 The subsequent parts of this International Standard intentionally do not make direct use of this term because under different circumstances it may be not possible to define exactly where a road ends. For this reason, reference will be made to artificial but more precisely definable road elements or road sections of the road network.

2.1.40
road crossing
location where two or more roads connect or intersect

NOTE A road crossing may be 'simple', corresponding to one junction, or 'complex', including internal road elements and junctions.

2.1.41
road element
linear section of the road network which is designed for vehicular movement having a junction at each end

NOTE It serves as the smallest unit of the road network at GDF Level 1 that is independent.

2.1.42
road section
road segment that is bounded by two intersections and has the same attributes throughout

NOTE 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.

2.1.43
road segment
part of a road, having its start and end along that road

NOTE Important difference between a road section and road segment is that the segment does not necessarily end at intersections.

2.1.44
shape point
intermediate coordinate pair to represent the shape of curved features

2.1.45
simple geometric area
explicit area with an outline defined by a simple geometric figure

2.1.46
simple object access protocol
SOAP
protocol providing a platform-independent way for applications to communicate with each other over the internet

NOTE SOAP technology relies on XML to define the format of the information and then adds the necessary HTTP headers to send it. Standardization is done within IETF: http://www.ietf.org/rfc.

2.1.47
subnetwork
plurality of road segments lying in geographical or topological conjunction to each other

2.1.48
synchronisation markup language
SyncML
data synchronisation protocol

NOTE A data synchronization protocol defines the workflow for communication during a data synchronization session when the mobile device is connected to the network. The protocol supports naming and identification of records, common protocol commands to synchronize local and network data, and it can support identification and resolution of synchronization conflicts.

2.1.49
topology
properties of spatial configuration invariant under continuous transformation

NOTE 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.

2.1.50
world geodetic system of 1984
WGS84
earth-centred global reference frame, including an earth model, based on satellite and terrestrial data

NOTE It contains primary parameters that define the shape, angular velocity, and the earth mass of an earth ellipsoid, and secondary parameters that define a gravity model of the earth. Primary parameters are used to derive latitude-longitude coordinates (horizontal datum).

2.2 UML expressions for diagrams

This International Standard uses UML to express specific circumstances. As such, the graphical elements are used to express specific constraints and structural relationships. A full definition can be found in the UML Standard ISO/IEC 19501. However, a short introduction of used elements is given in Annex C.