INTERNATIONAL STANDARD

ISO 19133

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Geographic information — Location-based services — Tracking and navigation

Information géographique — Services basés sur la localisation — Suivi et navigation

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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 19133 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

This International Standard is a description of the data and services needed to support tracking and navigation applications for mobile clients. The web services views of this International Standard are given in Annex C.

Geographic information — Location-based services — Tracking and navigation

1 Scope

This International Standard describes the data types, and operations associated with those types, for the implementation of tracking and navigation services. This International Standard is designed to specify web services that can be made available to wireless devices through web-resident proxy applications, but is not restricted to that environment.

2 Conformance

Conformance to this International Standard takes on two meanings dependent on the type of entity declaring conformance.

Mechanisms for the transfer of data are conformant to this International Standard if they can be considered to consist of transfer record or type definitions that implement or extend a consistent subset of the object types described within this International Standard.

Web servers for tracking and navigation are conformant to this International Standard if their interfaces implement one or more of the subtypes of service defined in this International Standard and their communications and messaging are accomplished using a conformant transfer mechanism.

Clauses 6 and 7 of this International Standard use the Unified Modeling Language (UML) to present conceptual schemas for describing the information and services for tracking and navigation. Clause 8 further describes a general schema for addresses to be used as location equivalents in three types of services. Clause 9 describes network data appropriate for these services. This International Standard concerns only externally visible interfaces and places no restriction on the underlying implementations other than what is needed to satisfy the interface specifications in the actual situation, such as

— interfaces to software services using techniques such as COM or CORBA;

— interfaces to databases using techniques such as SQL;

— data interchange using encoding as defined in ISO 19118.

Few applications will require the full range of capabilities described by this conceptual schema. This clause, therefore, defines a set of conformance classes that will support applications whose requirements range from the minimum necessary to define data structures to full object implementation. This flexibility is controlled by a set of UML types that can be implemented in a variety of manners. Implementations that define full object functionality shall implement all operations defined by the types of the chosen conformance class, as is common for UML designed object implementations. Implementations that choose to depend on external “free functions” for some or all operations, or forgo them altogether, need not support all operations, but shall always support a data type sufficient to record the state of each of the chosen UML types as defined by its member variables. Common names for “metaphorically identical” but technically different entities are acceptable. The UML model in this International Standard defines abstract types, application schemas define conceptual classes, various software systems define implementation classes or data structures, and the XML from the encoding standard (ISO 19118) defines entity tags. All of these reference the same information content. There is no difficulty in allowing the use of the same name to represent the same information content

even though at a deeper level there are significant technical differences in the digital entities being implemented.

Details of the conformance classes are given in the abstract test suite in Annex A.

3 Normative references

The following referenced documents are indispensable for the application 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 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 19107, *Geographic information — Spatial schema*

ISO 19108, *Geographic information — Temporal schema*

ISO 19109, *Geographic information — Rules for application schema*

ISO 19111, *Geographic information — Spatial referencing by coordinates*

ISO 19112, *Geographic information —Spatial referencing by geographic identifiers*

ISO 19118, *Geographic information — Encoding*

4 Terms and definitions

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

4.1
candidate route
any **route** that satisfies all constraints of the routing request with the possible exception of optimality of the **cost function**

NOTE Navigation is the process of finding the candidate route that optimizes a chosen cost function.

4.2
cost function
function that associates a measure (cost) to a **route**

NOTE The normal mechanism is to apply a cost to each part of a **route**, and to define the total **route** cost as the sum of the cost of the parts. This is necessary for the operation of the most common navigation algorithms. The units of cost functions are not limited to monetary costs and values only, but include such measures as time, distance, and possibly others. The only requirement is that the function be additive and at least non-negative. This last criteria can be softened as long as no zero or less cost is associated with any loop in the network, as this will prevent the existence of a “minimal cost” **route**.

4.3
Dijkstra graph
positively weighted directed graph appropriately configured to execute a shortest path search

NOTE The term comes from the most commonly known algorithm for finding a shortest path in a positively weighted graph, from E. Dijkstra’s paper [7]. Although this algorithm is not the only one in use, the requirements for the graph are common to most. The most common relaxation of the requirement is the “positive weights”, which are not needed in the Bellman–Ford algorithm [4], [8].

4.4
geocoding
translation of one form of **location** into another

NOTE Geocoding usually refers to the translation of “address” or “intersection” to “direct position”. Many service providers also include a “reverse geocoding” interface to their geocoder, thus extending the definition of the service as a general translator of **location**. Because routing services use internal **location** encodings not usually available to others, a geocoder is an integral part of the internals of such a service.

4.5
instantiate
to represent (an abstraction) by the creation of a concrete instance or to create the ability to create an instance

NOTE A class or data element definition instantiates a type if it creates the ability to create objects or data elements, respectively, that can represent the concepts (instance data and/or operations) defined by that type. A class is instantiated by an object if the class defines that object’s structure and function. A data schema is instantiated by a data element if the data schema defines that element’s structure.

4.6
junction
single topological node in a **network** with its associated collection of **turns**, incoming and outgoing **links**

NOTE Junction is an alias for node.

4.7
linear referencing system
linear positioning system [ISO 19116]
positioning system that measures distance from a reference point along a route (feature)

NOTE The system includes the complete set of procedures for determining and retaining a record of specific points along a linear feature such as the **location** reference method(s) together with the procedures for storing, maintaining, and retrieving **location** information about points and segments on the highways. [NCHRP Synthesis 21, 1974]

4.8
link
directed topological connection between two nodes (**junctions**), consisting of an edge and a direction

NOTE Link is an alias for directed edge.

4.9
link position
position within a network on a **link** defined by some strictly monotonic measure associated with that **link**

NOTE Link positions are often associated with a target feature that is not part of the network. The most common link measures used for this are the distance from start node or address. The most common use of a link position is to geolocate an “address”.

4.10
location
identifiable geographic place

[ISO 19112]

NOTE A location is represented by one of a set of data types that describe a **position**, along with metadata about that data, including coordinates (from a coordinate reference system), a measure (from a **linear referencing system**), or an address (from an address system).

4.11
location-based service
LBS
service whose return or other property is dependent on the **location** of the client requesting the service or of some other thing, object or person

4.12
location-dependent service
LDS
service whose availability is dependent upon the **location** of the client

4.13
main-road rule
set of criteria used at a **turn** in lieu of a **route instruction**; default instruction used at a node

NOTE This rule represents what is “most natural” to do at a node (intersection), given the entry link used. The most common version is “as straight as possible”, or to exit a **turn** on the most obvious extension of the entry street, which is usually, but not always, the same named street that was the entry. Every node in a route is either associated with an instruction or can be navigated by the main-road rule.

4.14
maneuver
manœuvre
collection of related **links** and **turns** used in a route in combination

NOTE Maneuvers are used to cluster **turns** into convenient and legal combinations. They may be as simple as a single **turn**, a combination of quick **turns** (“jogs” in the American mid-west consisting of a **turn** followed immediately by a **turn** in the opposite direction) or very complex combinations consisting of entry, exit, and connecting roadways (“magic roundabouts” in the UK).

4.15
navigation
combination of **routing**, **route transversal** and **tracking**

NOTE This is essentially the common term navigation, but the definition decomposes the process in terms used in the packages defined in this International Standard.

4.16
navigation constraint
constraint
restriction on how a **link** or **turn** may be traversed by a **vehicle**, such as **vehicle** classification, physical or temporal constraint

4.17
network
abstract structure consisting of a set of 0-dimensional objects called **junctions**, and a set of 1-dimensional objects called **links** that connect the **junctions**, each **link** being associated with a start (origin, source) **junction** and end (destination, sink) **junction**

NOTE The **network** is essentially the universe of discourse for the **navigation** problem. **Networks** are a variety of 1-dimensional topological complex. In this light, **junction** and topological node are synonyms, as are **link** and directed edge.

4.18
position
data type that describes a point or geometry potentially occupied by an object or person

NOTE A direct position is a semantic subtype of position. Direct positions as described can only define a point and therefore not all positions can be represented by a direct position. That is consistent with the “is type of” relation. An ISO 19107 geometry is also a position, just not a direct position.

4.19
route
sequence of **links** and/or partial **links** that describe a path, usually between two **positions**, within a **network**

4.20
route instruction
information needed at a point along a **route** in a **network** that allows that **route** to be traversed

NOTE To minimize the number of **instructions** needed to complete a **route traversal**, a default instruction can be assumed at **junctions** without specifically associated **instructions**. This default is called the **main-road rule**.

4.21
route traversal
process of following a **route**

4.22
routing
finding of optimal (minimal **cost function**) **routes** between **locations** in a **network**

4.23
slope
rate of change of elevation with respect to curve length

4.24
tracking
monitoring and reporting the **location** of a **vehicle**

4.25
traveller
person subject to being navigated or tracked

cf. vehicle

NOTE Includes pedestrians. See ISO 14825. In this International Standard, traveller can be replaced by **vehicle** without any change of intent.

4.26
traversable
condition of a **link** or **turn** that allows or restricts all traffic's traversal, as opposed to a more detailed **navigation constraint**

NOTE Traversability is usually a function of physical, cultural, or legal conditions. If traversable is false, then the object cannot be navigated. This effectively removes a **link** from the usable network. In the case of a node, it effectively removes the node and all associated **links** from the useable network. In the case of a **turn**, it simply removes it from any viable **route**. Non-traversable entities are not included in **maneuvers** or **routes**.

4.27
turn
part of a **route** or **network** consisting of a **junction** location and an entry and exit **link** for that **junction**

4.28
vehicle
object subject to being navigated or tracked

cf. traveller

NOTE Includes pedestrians. See ISO 14825. In this International Standard, vehicle can be replaced by **traveller** without any change of intent.