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Intelligent transport systems — Navigation systems — Application programming interface (API)

Systèmes intelligents de transport — Systèmes de navigation — Interface de programmation (API)

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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 17267 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

The impetus for this International Standard was the recognition by the intelligent transport systems (ITS) industry of the need for standardization with respect to data access for map databases used by navigation applications. As the vehicle navigation industry has grown, so has incompatibility between navigation systems and map databases. Both a standardized physical storage format (PSF) and a standardized navigation application programming interface (API) can facilitate the interoperability between navigation systems and map databases.

The purpose of this International Standard is to define and structure the model for data access for Vehicle Navigation and Traveller Information Systems. This International Standard is not restricted to physical media and will be independent of any underlying physical storage format. While this API is primarily targeted at self-contained in-vehicle systems, it is expected to be usable by other applications that use map data results in essentially the same way. For example, it may be usable by client/server or distributed navigation systems and location-based services without further specialization.

This International Standard is the Application programming interface (API) specification. It represents the comprehensive specification of the API standard for navigation applications. This International Standard builds upon, and is consistent with, the other International Standards developed by ISO/TC 204/WG 3:

— ISO 14825, *Intelligent transport systems — Geographic Data Files (GDF) — Overall data specification*;

— ISO 17572 (all parts), *Intelligent transport systems (ITS) — Location referencing for geographic databases*.

Intelligent transport systems — Navigation systems — Application programming interface (API)

1 Scope

This International Standard specifies an application programming interface (API) for navigation systems. It specifies the data that may be retrieved from the map database and defines the interface for access. This International Standard specifies a set of function calls. It also specifies the design of the API and gives examples of its intended use. Furthermore, it gives the criteria to determine whether a data access library is in accordance with this International Standard.

This International Standard is applicable to the following functional categories of navigation applications:

— positioning;

— route planning;

— route guidance;

— map display;

— address location;

— services and point of interest (POI) information access.

2 Terms and definitions

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

2.1
address location
application category that deals with the task of expressing a real world position in terms of the data representation

NOTE Address location is one of the six application categories supported by the API.

2.2
address type
attribute of road section entity that specifies the type of house number ranges

EXAMPLE Distinction between base address, county address, commercial address, etc., or no address.

2.3
application category
basic sub-function within the set of functionality for vehicle navigation and traveller information system applications

NOTE This International Standard identifies six application categories: positioning; route planning; route guidance; map display; address location; services and POI information access.

2.4
application programming interface
API
standard interface and set of function calls between application software and data access libraries of vehicle navigation systems, in accordance with this International Standard

2.5
base map
all transportation elements and all services, including their relationships to transportation elements

2.6
branded third-party data
BTPD
information about services which is supplied by third-party data providers (e.g. tourist or motoring organizations), who may impose proprietary restrictions on the use and presentation of the data

NOTE 1 Access is subject to authorization and licensing.

NOTE 2 BTPD is a subset of third party data (TPD); see 2.54.

2.7
cartographic feature
data model entity that represents geometrical information for display purposes

NOTE A cartographic feature has non-explicit topology; it has zero-, one- and two-dimensional types, i.e. Display Point, Polyline, and Polygon.

2.8
cartographic text
data model entity that stores name text associated with all or part of a cartographic feature

NOTE Cartographic text is language dependent and may contain a suggested display location, orientation, language code, priority (or importance), suggested scale range, and bounding box.

2.9
condition
information related to link(s) composed of condition type, condition modifiers, and condition scope

2.10
crossroad
data model entity that represents the single instance of the crossing of two named navigable features

NOTE Crossroad relates to the set of links and nodes which comprise the crossing, and to the crossing of the navigable features to a place.

2.11
destination node
node at the end of the link toward which travel takes place

NOTE See also origin node (2.25), “from” node (2.14), “to” node (2.55), source node (2.50), and target node (2.53). When a link is travelled in the direction of topological orientation, the destination node is the “to” node. When it is travelled in the direction opposite topological orientation, the destination node is the “from” node.

2.12
display point
zero-dimensional type of cartographic feature

2.13
dummy point
optional entity that represents a position along a link where the link crosses a parcel boundary and does not necessarily coincide with a shape point or node

2.14
"from" node
node at the end of a link away from which the link is topologically oriented

NOTE See also "to" node (2.55), origin node (2.25), destination node (2.11), source node (2.50), and target node (2.54). When a link is travelled in the direction of topological orientation, the "from" node is the origin node. When it is travelled in the direction opposite topological orientation, the "from" node is the destination node.

2.15
geocoding
determination of a link or node based on address information describing and/or naming a location

2.16
intersection
geographic data file (GDF) level 2 representation of a crossing which bounds a road or a ferry as a complex feature composed of one or more GDF level 1 junctions, road elements and enclosed traffic areas

2.17
junction
data model entity that represents a navigable feature which is either a named GDF junction or named GDF intersection, and that relates a named navigable feature to a set of links and nodes and a place

2.18
landmark
point, line, or area feature, possibly associated with a node or link, that can be used to clarify the directions generated to describe a route

NOTE A landmark may not be in the Services, Administrative Areas, or Public Transportation feature themes of a GDF; a facility in which a service is located may be a landmark.

2.19
layer
subset of map data resulting from a subdivision of data of the same coverage area based on contents and which is typically related to one or only a few of the application categories

NOTE This is similar to an ISO-GDF layer.

EXAMPLE Route guidance data may be considered as one layer.

2.20
level
subset of map data resulting from a classification of data of the same semantic content based on the level of detail or density, related to the concept of different map scales

NOTE Level 0 is considered the lowest level (greatest detail); higher levels are numbered level 1, level 2, etc.

EXAMPLE Map display data may be organised into 6 levels representing different zoom scales.

2.21
link
directed topological connection between two nodes, composed of an ordered sequence of one or more segments and represented by an ordered sequence of zero or more shape points (2.48)

2.22
map display
application category that deals with graphical information presentation

NOTE Map display is one of the six application categories supported by the API.

2.23
multilink
ordered aggregation of links which are at the same level, are connected in sequence, and share the same functional classification, form of way, direction of travel, and perhaps additional characteristics

EXAMPLE Each link is contained in exactly one multilink.

2.24
navigable feature name
data model entity that represents the name for the transportation element, including GDF road element, GDF ferry connection, GDF junction, GDF intersection

NOTE Navigable feature name is related to places, crossroads, junctions, and road sections.

2.25
node
data model entity for a topological junction of two or more links or for end-bounding a link

NOTE A node stores the coordinate value of the corresponding GDF junction.

2.26
origin node
node at the end of a link from which travel takes place

NOTE See also destination node (2.11), "from" node (2.14), "to" node (2.55), source node (2.50), and target node (2.54). When a link is travelled in the direction of topological orientation, the origin node is the "from" node. When it is travelled in the direction opposite topological orientation, the origin node is the "to" node.

2.27
parcel
database partitioning unit corresponding to a certain coverage area, associated with one level and containing data of one or more layers

NOTE A parcel contains (at least) all nodes with positions enclosed by or located on the outline of its coverage area plus (parts of) all links attached to these nodes; it can be partitioned so that the amount of data of a parcel may be nearly the same as that of another.

2.28
place
named area which can be used as part of the address location

2.29
place class
attribute of place entity, classifying into highest administrative or geographic division, administrative subdivision, postal, or colloquial (e.g. regions or neighbourhoods)

NOTE Place class can be partially ordered as "place class A is below place class B". This does not imply strict or complete containment.

2.30
place level
level associated with places of place classification "administrative subdivision"

NOTE Higher/lower level situations are constituted by the occurrence of a parent/child place relationship between places.

2.31
place relationship
bivalent relationship between place entities, constituting the place tree linking parent and child places

EXAMPLE Place A is in place B.

NOTE Place relationship does not imply strict or complete containment. It is attributed as: address significant, official, postal or useful for reverse geocoding.

2.32
point of interest
POI
destination and/or site of interest to travellers, usually non-commercial by nature

2.33
polygon
two-dimensional type of cartographic feature

2.34
polyline
one-dimensional type of cartographic feature

2.35
positioning
application category that deals with the determination of vehicle location and map matching

NOTE Positioning is one of the six application categories supported by the API.

2.36
postal code
data model entity for a government-designated code used to specify regions for addressing

NOTE Postal code is related to link (2.21), navigable feature name (2.23), place (2.27), and POI (2.31).

2.37
rectangle
unit of geographic space defined by two parallels of min./max. latitude and by two meridians of min./max. longitude and that represents the coverage area of the map data enclosed by or located on its outline

2.38
reverse geocoding
determination of the address description of a link or node, i.e. determination of an upwards path across the place tree

2.39
road
GDF level 2 feature composed of one, many or no road elements and joining two intersections, serving as the smallest independent unit of a road network at GDF level 2

2.40
road element side
RES
basic component of the road section entity that represents left or right side of a link and corresponds to one or more unique combinations of a navigable feature and a house number range

2.41
road section
data model entity that represents the house number ranges of both sides of a street and that carries a navigable feature name

NOTE Road section corresponds to a link (ID).

2.42
route guidance
application category that deals with the generation of graphical, textual, and/or audio instructions for following a planned route

NOTE Route guidance is one of the six application categories supported by the API.

2.43
route planning
application category that deals with the determination of routes between specified points

NOTE Route planning is one of the six application categories supported by the API.

2.44
segment
straight section of a link connecting two successive shape points, or a shape point and a node, or two nodes where a link does not contain shape points

2.45
service
data model entity for a commercial activity of interest to travellers as a destination and/or orientation that is associated with road element(s) by which it can be accessed and further described by attributes including (at least) name and type

NOTE A service may be associated with other services by parent/child relationships (many to many). Service is used synonymously with POI within the logical data model.

2.46
service attribute
item of descriptive information relating to a service

2.47
services and POI information access
application category that deals with the provision of POI information to the navigation application

NOTE Services and POI information access is one of the six application categories supported by the API.

2.48
shape point
position along a link used to more accurately represent its geometric course, bounded by exactly two segments

2.49
signpost
data model entity for a directional sign that represents a logical relationship between signpost information and two associated links

NOTE The first link (mandatory) represents the road element along which the signpost is located. The second link (optional) is the first road element which directs exclusively to the destination indicated on the signpost. The position of the signpost along the link and the link direction the signpost is facing is also stored.

2.50
source node
node at the end of a link from which exploration takes place for route calculation

NOTE See also target node (2.53), origin node (2.25), destination node (2.11), “from” node (2.14), and “to” node (2.55). When forward exploration is taking place from the origin of the route, the source node of a link is its origin node. When reverse exploration is taking place from the destination of the route, the source node of a link is its destination node.

2.51
super link
aggregation of linearly connected regular links present in the lowest level as a simplified representation of the road network in higher levels

2.52
symbol
data model entity that represents an icon associated with a cartographic feature

2.53
target node
node at the end of a link towards which exploration takes place for route calculation

NOTE See also source node (2.50), origin node (2.25), destination node (2.11), "from" node (2.14), and "to" node (2.56). When forward exploration is taking place from the origin of the route, the target node of a link is its destination node. When reverse exploration is taking place from the destination of the route, the target node of a link is its origin node.

2.54
third party data
TPD
information about services, which is supplied by third party data providers (e.g. tourist or motoring organizations), typically with a rich content of descriptive data

2.55
"to" node
node at the end of a link towards which the link is topologically oriented

NOTE See also "from" node (2.14), origin node (2.25), destination node (2.11), source node (2.50), and target node (2.54). When a link is travelled in the direction of topological orientation, the "to" node is the destination node. When it is travelled in the direction opposite topological orientation, the "to" node is the origin node.

2.56
traffic location
data model entity that contains an external reference (e.g. VICS or RDS-TMC) and is linked to either place or transportation entities

2.57
transportation element
feature from the Roads and Ferries feature theme of a GDF

3 Abbreviated terms

ANSI	American National Standards Institute
CPU	Central Processing Unit
DAL	Data Access Library
DBID	Database ID
DST	Daylight Savings Time
EEPROM	Electrically Erasable and Programmable Read-Only Memory
GDF	Geographic Data File
GMT	Greenwich Mean Time

HOV	High Occupancy Vehicle
HTML	HyperText Markup Language
IDL	Interface Definition Language
MIME	Multipurpose Internet Mail Extensions
OMG	Open Management Group
OS	Operating System
PSF	Physical Storage Format
RDS-TMC	Radio Data System-Traffic Message Channel
VICS	Vehicle Information and Communication System

4 Architecture of the API

4.1 General

Subclauses 4.2 to 4.13 specify the architecture requirements for the design of the ISO-API. Implementation details are not specified in this International Standard.

4.2 Paradigm

The ISO-API shall be specified in an object-oriented way.

4.3 Minimum low level platform interface

It is not necessary to define a minimum low level platform interface as long as a system-independent data access library is not feasible.

4.4 Forward compatibility

The ISO-API shall support forward compatibility in such a way that

— earlier versions of application software can use DALs corresponding to later ISO-API versions, and

— earlier versions of DAL can use data in later PSFs.

The mechanism for forward compatibility shall be entirely hidden from the API.

4.5 Error handling

The application software shall be responsible for handling errors; more specifically, the DAL gives notification of errors while the application software reacts on them.

The ISO-API shall specify a list of error conditions for each function call. The system designer can decide which error mechanism to use for the implementation.

4.6 Memory allocation

The lifetime of the objects and structures shall be controlled by the application software. Memory for objects and structures used internally by the DAL is managed by the DAL.

4.7 Prioritization and cancellation

The ISO-API shall support prioritization and cancellation to control input/output (I/O) operations, perform intelligent caching, etc. This functionality shall be supported by the ISO-API in the following way: Each class (object-orientation!) shall have two member functions "setPriority()" and "getPriority()". Due to this, the application software is able to assign, query and change the priority for an instance of this class. If the application software does not want to use this mechanism, it can assign the same value for each instance. There is no mandated behaviour of the DAL based on the application-specified priorities. The behaviour of the DAL is defined by the DAL supplier.

4.8 Byte ordering

Depending on the hardware (and operating system) of a navigation system, the data values will be physically used in one of two ways.

— Little endian: The least significant byte (LSB) of a value will be stored physically first, e.g. in systems with Intel CPUs.

— Big endian: The most significant byte (MSB) of a value will be stored physically first, e.g. in systems with Motorola 68k CPUs.

Some CPUs are bi-endian, such as R3000 ff, PowerPC. In such a case, the byte order is defined by the operating system.

The following data values are concerned:

— integer values (16, 32, 64 bit);

— floating point values (32, 64, 128 bit);

— characters (16 bit, multibyte).

An ISO-API compliant DAL shall return the data values in the byte order being used by the CPU/OS of the navigation system where the DAL is running. This shall happen regardless of whether a PSF is stored in little endian or big endian byte order. Therefore, a conversion inside the DAL may be necessary. The performance loss shall be minimized by doing the conversion on the lowest level.

4.9 Generic data types

Because the target systems are different it is necessary to define generic system-independent data types to be used for the ISO-API. They are translated by the DAL into the data types of the target system. The generic data types listed in Table 1 shall be defined for the ISO-API.