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**Intelligent transport systems —
Extension of map database
specifications for Local Dynamic Map
for applications of Cooperative ITS**

*Systèmes intelligents de transport — Extension des spécifications de
base de données cartographiques pour cartes dynamiques locales aux
applications collaboratives des SIT*

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

ISO/TS 17931 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This corrected version of ISO/TS 17931 contains higher quality figures in [Annex D](#), which improve legibility.

Introduction

The purpose of this proposal is to extend the existing specifications for map databases in order to provide greater support for applications and/or application developments of Cooperative ITS that may use Local Dynamic Map.

The functional requirements and data model for in-vehicle navigation are already defined in ISO/TS 20452. However, the map-related functional requirements, data model, and data elements needed for Local Dynamic Map for Cooperative ITS have not yet been defined.

This proposal can help developers of applications for Cooperative ITS by broadening its applicability. Such applications will benefit by the availability of a standardized data model and data elements. The resulting work will shorten developers' time-to-market for new products and services.

The scope of this proposal is within the scope of ISO 14296¹⁾ which was approved in April, 2011. However, in order to meet the schedule requirement of Mandate M/453 issued by European Commission, the scope of this proposal is limited to publishing a Technical Specification for the Local Dynamic Map component of ISO 14296.

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1) Under preparation.

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Intelligent transport systems — Extension of map database specifications for Local Dynamic Map for applications of Cooperative ITS

1 Scope

This Technical Specification provides the map-related functional requirements, data model (logical data model/logical data organization), and data elements for Local Dynamic Map for those applications of Cooperative ITS that require information derived from map databases.

It is focused on data elements of a static nature.

2 Conformance

Data structures shall be provided as specified in [Clauses 8](#).

Any data structure claiming conformance with this Technical Specification shall pass the requirements presented in the abstract test suite in [Annex A](#).

UML Expressions for diagrams in this Technical Specification shall be compliant with ISO/IEC 19501:2005.

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 14825:2011, *Intelligent transport systems — Geographic Data Files (GDF) — GDF5.0*

ISO/TS 20452:2007, *Requirements and Logical Data Model for a Physical Storage Format (PSF) and an Application Program Interface (API) and Logical Data Organization for PSF used in Intelligent Transport Systems (ITS) Database Technology*

ETSI TC ITS TR 102638, *Basic set of applications definitions*

ETSI TC ITS TR 102863, *Intelligent Transport Systems (ITS); Vehicular Communications; Basic set of applications; Local Dynamic Map (LDM); Rationale for and guidance on standardization*

4 Terms and definitions

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

4.1

Address Location

application category that deals with the task of expressing a real-world position in terms of the PSF data representation

Note 1 to entry: Address Location is one of the six application categories.

4.2

Advisory Point

data model entity that provides information about an approaching condition on a road that may require some action by the driver of a vehicle

4.3

Application category

basic sub-function within the set of functionality for vehicle navigation and traveler information system applications

Note 1 to entry: This Technical Specification identifies six application categories: Positioning, Route Planning, Route Guidance, Map Display, Address Location, Services and POI Information Access.

4.4

Background

data model package that is composed of Background Imagery, Map Data Background, Cartographic Feature Type, Figure Element and Picture file entity for displaying Map

4.5

Background Imagery

data model entity that provides background images upon which the road network of an area may be displayed

4.6

Building & Facility

data model entity that provides the location and shape of road side features such as a toll gate, or a fixed Road Side ITS station

4.7

Cartographic

data model package represents geometric information for display purposes, having non-explicit topology and 0-, 1- and 2-dimensional types and images

4.8

Cartographic Feature Type

data model entity that provides cartographic feature by their type (Symbol, Point, Polyline and Polygon)

4.9

Caution Point

data model entity that provides warning information about an approaching potential hazard on the Road Elements that may require some action by the driver of a vehicle

4.10

Detailed Special Route

data model entity that provides the detailed information of Special Route such as the ordered sequence of Link and Intersection lists, length of route and fee of toll road

4.11

Direction Guide

data model entity that provides the guidance information for a path which is composed of the entrance Link and the exit Link connected to an Intersection

4.12

Display point

0-dimensional type of cartographic feature

4.13

District Name

data model entity that provides the name of a geographic area feature for each Link connected to an intersection

4.14

Figure Element

data model entity that provides the shape data of a cartographic feature for displaying a map

4.15**Geocoding**

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

4.16**Graphic Text**

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

Note 1 to entry: It is language-dependent and can contain a suggested display location, orientation, language code, priority (or importance), suggested scale range, and bounding box.

4.17**Intersection**

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

4.18**Intersection Connecting Point**

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

Note 1 to entry: A link stores the coordinate value of the corresponding GDF junction.

4.19**Intersection Cost**

data model entity that provides the time or monetary cost between the entrance Link and exit Link of Intersection for calculating route

4.20**Intersection Link**

data model entity that provides the Links in the Intersection used for determining the path through an intersection

4.21**Intersection Link Shape**

data model entity that provides the shape of the Intersection Link for displaying a path

4.22**Intersection Name**

data model entity that provides the name of an Intersection. An Intersection may have one or more names corresponding to the direction of entering into the intersection

4.23**Junction**

it 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

4.24**Landmark**

point, line or area feature that can be used to clarify the directions generated to describe a route

Note 1 to entry: It can be associated to a node or a link.

Note 2 to entry: A Landmark cannot be in the Services, Administrative Areas, or Public Transportation Feature themes of the GDF; however a facility in which a service is located can be a landmark.

4.25**Lane**

data model entity that provides the lane information such as lane direction or lane width of Road Element

4.26**Lane Shape**

data model entity that provides the shape geometry of the lane

4.27

Layer

sub-set of map data resulting from a subdivision of data of the same coverage area based on contents (similar to ISO-GDF layer) and which is typically related to one or only a few of the application categories

EXAMPLE Route guidance data can be considered as one layer.

4.28

Level

sub-set of map data resulting from classification of data of the same semantically contents based on the level of details/density, related to the concept of different map scales

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

EXAMPLE Map display data can be organized into 6 levels representing different zoom scales.

4.29

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

4.30

Link Cost

data model entity that provides the time or monetary cost of the Link for calculating route

4.31

Local Dynamic Map

a conceptual data store which is embedded in an ITS station and which contains topographical, positional and status information

4.32

Location Image

data model entity that provides a background image of the Road Element and the intersection upon which guidance information is displayed

4.33

Map Data Background

data model entity that provides map database features for background display

4.34

Map Display

application category that deals with graphical information presentation

Note 1 to entry: Map Display is one of the six application categories.

4.35

Multilink

ordered aggregation of links which are at the same level, connected in sequence, share the same functional classification, form of way, direction of travel, and perhaps additional PSF-builder-specified characteristics, such that each link is contained in exactly one multilink

4.36

Parcel

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

Note 1 to entry: 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.

Note 2 to entry: It can be partitioned such that the amount of data of one parcel is nearly the same as that of another.

4.37**Picture File**

this entity is the file of picture object

4.38**Place**

named area which can be used as part of address location

4.39**Place Reference Point**

data model entity that provides a representative point within a Place

4.40**Point of Interest**

destination and/or site of interest to travelers, usually non-commercial by nature

4.41**Polygon**

2-dimensional type of cartographic feature

4.42**Polyline**

1-dimensional type of cartographic feature

4.43**Positioning**

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

Note 1 to entry: Positioning is one of the six application categories.

4.44**Rectangle**

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

4.45**Regular parcel**

parcel shaped like a rectangle

Note 1 to entry: Regular parcels on the same generalization level are not intended to overlap.

4.46**Reverse geocoding**

determination of the address description of a link or node (i.e. determination of an upwards path across the place tree)

4.47**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

4.48**Road Bridge and Tunnel**

data model entity that provides information such as the length, height and slope of bridges and tunnels

4.49**Road Element**

data model entity that is a primitive road feature. Road Element is the same as the Link except for connecting to the Intersection

Note 1 to entry: Road Element is the same as Link.

4.50

Road Element Shape

data model entity that provides the shape geometry of the Road Element for displaying Road and Positioning

4.51

Route Guidance

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

4.52

Road Marking

data model entity that provides the shape of painted markings on roads such as lane markings these may be used for display purposes

4.53

Road Section

data model entity that is represented by an ordered sequence of one or more Road Element

4.54

Road Signage

data model entity that provides the detailed text of the road signage on the Road Element

Note 1 to entry: Route Guidance is one of the six application categories elements and joining two intersections, serving as the smallest independent unit of a road network at GDF level 2.

4.55

Route Planning

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

Note 1 to entry: Route Planning is one of the six application categories.

4.56

Segment

straight section of a link connecting either two successive shape points, or a shape point and a node, or two nodes in case the link does not contain shape points

4.57

Service

data model entity for a commercial activity of interest to travelers as a destination and/or orientation that is associated with Road Element(s), by which it can be accessed, and place(s)

Note 1 to entry: Service is further described by attributes including (at least) name and type; it can be associated with other services by parent/child relationships (many to many).

Note 2 to entry: Service is used synonymously with POI within the logical data model.

4.58

Service and POI Information Access

application category that deals with the provision of POI information to the navigation application

Note 1 to entry: Services and POI Information Access is one of the six application categories.

4.59

Service and POI Reference Point

data model entity that provides a representative point of a Service and POI

4.60

Shape point

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

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4.61**Special Route**

data model entity that provides the pre-determined route such as scenic route or highway route

4.62**Street Address**

data model entity that provides the geocoded Street Address of the Road Element

4.63**Symbol**

it represents an icon associated with a cartographic feature

4.64**Topological Road Network**

data model package that is composed of Road Element, Intersection, Link Cost, Intersection Cost, Traffic Restriction, Special Route and Detailed Special Route

4.65**Traffic Location**

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

4.66**Traffic Restriction**

data model entity that provides the traffic restrictions such as one way or turn restrictions for route calculation purposes

4.67**Transportation element**

any feature from the Roads and Ferries feature theme of the GDF

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5 UML Expressions for diagrams

This Technical Specification uses UML to express specific circumstances; the graphical elements are used to express specific constraints and structural relationships. A full definition can be found in ISO/IEC 19501:2005. However, a short introduction of elements is given in [Annex B](#).

6 Symbols (and abbreviated terms)

ADAS Advanced Driver Assistance System

BSA Basic set of applications

DB Database

GDF Geographic Data File

ITS Intelligent Transport System

LDM Local Dynamic Map

LDO Logical Data Organization

POI Point of Interest

PSF Physical Storage Format

7 Requirements

7.1 Introduction

This Technical Specification defines application requirements and functional requirements.

7.2 Application Requirements

This Technical Specification supports Basic set of applications of Cooperative systems, Driving support services, and navigation services.

Basic set of applications of Cooperative systems are defined in [Annex C](#). Driving support services are defined in [Annex D](#). Relationship between Basic set of applications of Cooperative systems and Driving support services are defined in [Annex F](#).

7.3 Functional Requirements

7.3.1 Overview

Six functions (Map Display, Positioning, Route Planning, Route Guidance, Service/POI Information Access and Address Location) are the same as ISO/TS 20452:2007. The other functions are newly defined by this technical specification.

7.3.2 Map Display

7.3.2.1 General Description

The Map Display function is used to display a map of a specified geographic area. An application may display maps to the end-user. The application may also accept end-user input that references the map display (such as from a point and click device).

7.3.2.2 Functional Description

An application may display Points Features, Lines Features, Areas Features, Cartographic Text and Symbols for a specified geographic area. This may include roads, physical features, administrative boundaries, and names for all of these. Text and symbols can be positioned on a display to annotate this map.

The Map Display function provides cartographic data that can be used to display a map of any application specified arbitrarily-oriented rectangle in the database. The data consist of the following database entities to support a variety of map drawing styles: Cartographic Features, Cartographic Text and Symbols.

The application may allow the map to be zoomed in or out. The application may display different levels of detail on a map display based on the zoom level. The application may allow the map to be rotated and scrolled. When scrolling, if detailed data are not available, the application may automatically zoom the map out to a level where data are available. The application may allow the end-user to access additional information by selecting objects on the display. The application may display multiple windows. Generating map images and managing displays are beyond the scope of this function.

To facilitate data access speed, this application groups cartographic data into levels. The higher levels contain only the more significant cartographic features. The set of cartographic data is also selectable by level.

7.3.2.3 Requirements for Data model

Map Display provides the following methods of accessing data:

- R-1. via the Cartographic Features, Cartographic Text and Symbols for an application-specified rectangle, *level* and *Feature type*;

- R-2. via the coordinates for application-specified Cartographic Features;
- R-3. via attributes for Cartographic Features, such as: feature type, name, and functional classification;
- R-4. via the complete or partial Cartographic Features associated with application-specified Transportation Elements;
- R-5. via the area (size) of an application-specified *Area Feature*;
- R-6. via the ability to retrieve additional information for *Point, Line and Area Features* which are associated with Cartographic Features which may have been selected from the displayed map;
- R-7. via the Cartographic Text associated with a Cartographic Feature;
- R-8. via the Symbol associated with a Cartographic Feature;
- R-9. via returning the Cartographic Features and Cartographic Text in “draw-order”. For example, if water is drawn before bridges, water features should be returned before bridge features.
- R-10. When no map data are available for an area requested by a function, the function may distinguish between the case of “off the map” and the case of “no data at this location at this *level*”.
- R-11. The API shall allow a pre-fetch area of interest to be specified by a rectangle and application specified *level* for retrieving Map Display data.
- R-12. display a map at the current location of the navigation system;
- R-13. display a marker on the map indicating the navigation system’s current location;
- R-14. scroll the displayed map as the navigation system moves, maintaining the position of the marker indicating the navigation system’s current location;
- R-15. display a map at any location selected by the end-user. The end-user may specify the location as an address, an intersection, a service, or by cursor position on the display;
- R-16. provide latitude and longitude, street address, and other information for a point indicated by the cursor on the display;
- R-17. highlight a route on the display;
- R-18. highlight the point on a displayed map of a particular routing maneuver.
- R-19. Several *levels* of data are required for cartographic data, corresponding to different map scale ranges. At the higher *levels*, the drawing detail for line features and area features is generalized.
- R-20. Access is required for data from all GDF Feature Themes, as well as attributes and conditions.
- R-21. Map display data shall be organized into Parcels.
- R-22. In order to allow easy identification of Parcels, Parcels shall be rectangular.
- R-23. Links crossing Parcel boundaries shall be cut at the Parcel boundary.
- R-24. In order to minimize the number of Parcels accessed, any link crossing into a parcel, with or without a node or *intermediate point* in that Parcel, shall be represented in that parcel.

7.3.3 Positioning

7.3.3.1 General Description

The Positioning function is used to determine vehicle location, for example latitude and longitude of a road network entity and for Map Matching. Map Matching is the method of determining where the navigation