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Intelligent transport systems — Dynamic data and map database specification for connected and automated driving system applications — Part 1: Architecture and logical data model for harmonization of static map data

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Contents

Foreword

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

A list of all parts in the ISO 22726 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.

Introduction

In response to emerging automated driving system (ADS) development, a new requirement for an intelligent transport system (ITS) map database standard has been raised to define a set of models for highly confident map data.

The data used in ADS are categorized into static data (i.e. map for highly automated driving (MHAD) and traditional map data) and dynamic data (e.g. traffic and travel information). These data are mutually related and linked to support ADS. The data model for ADS should have a structure specialized for automated driving and be presented in a manner useable for ADS.

In the case of static map data used by ITS, ISO 14296 specifies a logical data model applied to vehicle navigation systems and cooperative ITS (C-ITS). The data model of ISO 14296:2016 is insufficient for ADS because of limitations to represent detailed or accurate carriageway and road-related features. In addition, new relationships between new map features and dynamic data are defined.

Even though GDF 5.1 (ISO 20524-2) defines map data used in ADS such as road belts or lane belts as detailed road map data, it focuses on a data model for exchanging and provisioning map data between map makers and data centres. The GDF model which is based on three catalogues (Feature, Attribute, and Relationship) is inefficient not only for storing ITS map data in a database but also to be able to access that data rapidly in vehicles. Therefore, this document defines a database standard to quickly and directly access detailed road map entities and their related information.

The purpose of this Technical Specificationdocument is to define a data model for connected and automated driving systemsystems.

Implementation of this specification coulddocument can potentially lead to cost reductions in maintenance, and expansion of map access libraries, as well as reductions in compilation, and maintenance costs of map and map-related data for data providers for connected and automated driving, and vehicle control applications.

Intelligent transport systems — Dynamic data and map database specification for connected and automated driving system applications — Part 1: Architecture and logical data model for harmonization of static map data

1 Scope

This document specifies the architecture and the logical data model of static map data for connected and automated driving system applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 14296:2016, Intelligent transport systems -- Extension of map database specifications for applications of cooperative ITS

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

ISO 20524-1:2020, Intelligent transport systems — Geographic Data Files (GDF) GDF5.1 — Part 1: Application independent map data shared between multiple sources

ISO 20524-2:2020, Intelligent transport systems — Geographic Data Files (GDF) GDF5.1 — Part 2: Map data used in automated driving systems, Cooperative ITS, and multi-modal transport.

ISO/IEC 19501, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/https://www.electropedia.org/

3.1
belt
configuration concept for specifying an area bounded by side lines and terminal lines, characterized by directions and represented as one or more linear axes when skeletonized

Note 1 to entry: The number of skeletonized axes differs depending on the feature class. In the case of a belt applied to a one-way lane, the number is one. When applied to an intersection, the belt has axes corresponding to the number of unique allowable traffic directions.

[SOURCE: ISO 20524-2:2020, 3.2]

3.2
direction
signature of belt, determined by an allowed connection between a pair of terminal lines

[SOURCE: ISO 20524-2:2020, 3.3]

3.3
belt feature
two-dimensional Feature, represented by belt concept, bounded by three or more Edges or four or more NET coordinate Tuple

[SOURCE: ISO 20524-2:2020, 3.1], modified — "represented by belt concept" added.]

3.4
feature
database representation of a real-world object

[SOURCE: ISO 20524-1:2020, 3.4.9]

3.5
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

[SOURCE: ISO/TS 20452:2007, 3.19]

3.6
node
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.

[SOURCE: ISO/TS 20452:2007, 3.23]

3.7
partition line
transversal line representing the boundary of a segment set to a road belt element and a lane belt element, and both terminations are set on the sideline of road belt element or lane belt element

3.8
probe data
vehicle sensor information formatted as probe data elements and/or probe messages that are processed, formatted and transmitted to a land-based centre for processing to create a good understanding of the driving environment

[SOURCE: ISO 24100:2010, 3.14]

3.9
road feature
feature, specified by a belt, that represents an area for vehicle travel

EXAMPLE: Carriageways, intersections, and lanes are examples of road features.

Note 1 to entry: ItThis is a general term for the roadway, carriageways, intersections, and lanes, and does not contain the sidewalks, and paths for pedestrians.

3.10
sideline
side line
type of boundary line constituting a belt feature other than a terminal line

[SOURCE: ISO 20524-2:2020, 3.4, modified — The alternate form admitted term "side line" has been added as the admitted term.]

3.11
terminal line
a type of boundary line constituting a belt feature and designated for determining a direction of a belt feature in combination with another terminal line

[SOURCE: ISO 20524-2:2020, 3.5]

4 Abbreviated terms and symbols

ADS Automated Driving System

C-ITS Cooperative ITS

GNSS Global Navigation Satellite System

IAP IntersectionAnchorPosition

IB IntersectionBelt

IBSd IntersectionBeltSideline

IBTr IntersectionBeltTerminalLine

ICP IntersectionConnectionPoint

ITS Intelligent Transport System

LAP Lane Anchor Position

LBE LaneBeltElement

LBJ LaneBeltJoint

LBSd LaneBeltSideline

LBSg LaneBeltSegment

LBSSg LaneBeltSidelineSegment

LBTr LaneBeltTerminalLine

LCP LaneConnectionPoint

MHAD Map for Highly Automated Driving

POI Point of Interest

RAP RoadAnchorPosition

RBE RoadBeltElement

RBS RoadBeltSection

RBSg RoadBeltSegment

RBSd RoadBeltSideline

RBSSg RoadBeltSidelineSegment

RBTr RoadBeltTerminalLine

RSE RoadStructuresAndEquipment

RTK-GPS Real Time Kinematics - Global Positioning System

ADS	automated driving system
C-ITS	cooperative ITS
CMS	changeable message sign
GNSS	Global Navigation Satellite System
IAP	IntersectionAnchorPosition
IB	IntersectionBelt
IBSd	IntersectionBeltSideline
IBTr	IntersectionBeltTerminalLine
ICP	IntersectionConnectionPoint
ITS	intelligent transport system
LAP	lane anchor position
LBE	LaneBeltElement
LBJ	LaneBeltJoint
LBSd	LaneBeltSideline
LBSg	LaneBeltSegment

LBSSg	LaneBeltSidelineSegment
LBTr	LaneBeltTerminalLine
LCP	LaneConnectionPoint
MHAD	map for highly automated driving
POI	point of interest
RAP	RoadAnchorPosition
RBE	RoadBeltElement
RBS	RoadBeltSection
RBSg	RoadBeltSegment
RBSd	RoadBeltSideline
RBSSg	RoadBeltSidelineSegment
RBTr	RoadBeltTerminalLine
RSE	RoadStructuresAndEquipment
RTK-GPS	real time kinematics - global positioning system
VMS	variable message sign

5 Document structure and conformance

5.1 Document structure

This document contains the following main clauses, subclauses and annexes:

— Conformance (5.2)

— Architecture (Clause 6)

— Logical data model of map data (Clause 7)

— Overall data model of map data (7.1)

— Transportation package (7.2)

— MHAD package (7.3)

— Relationship to dynamic information (7.4)

— Annex A (normative) Abstract test suite

— Annex B (normative) Basic data types and stereotypes

— Annex C (informative) Rsolution and accuracy of the MHAD

— Annex D (informative) Comparison of the road network models of MHAD and existing map models

~~5~~5.2 Conformance

Data model structures shall be provided as specified in Clause 7.

Any data structure claiming conformance with this document shall pass the requirements presented in the ~~Abstract~~abstract test suite in Annex A.

UML ~~Expressions~~expressions for diagrams in this document shall ~~be compliant with~~conform to ISO/IEC 19501~~:2005~~.

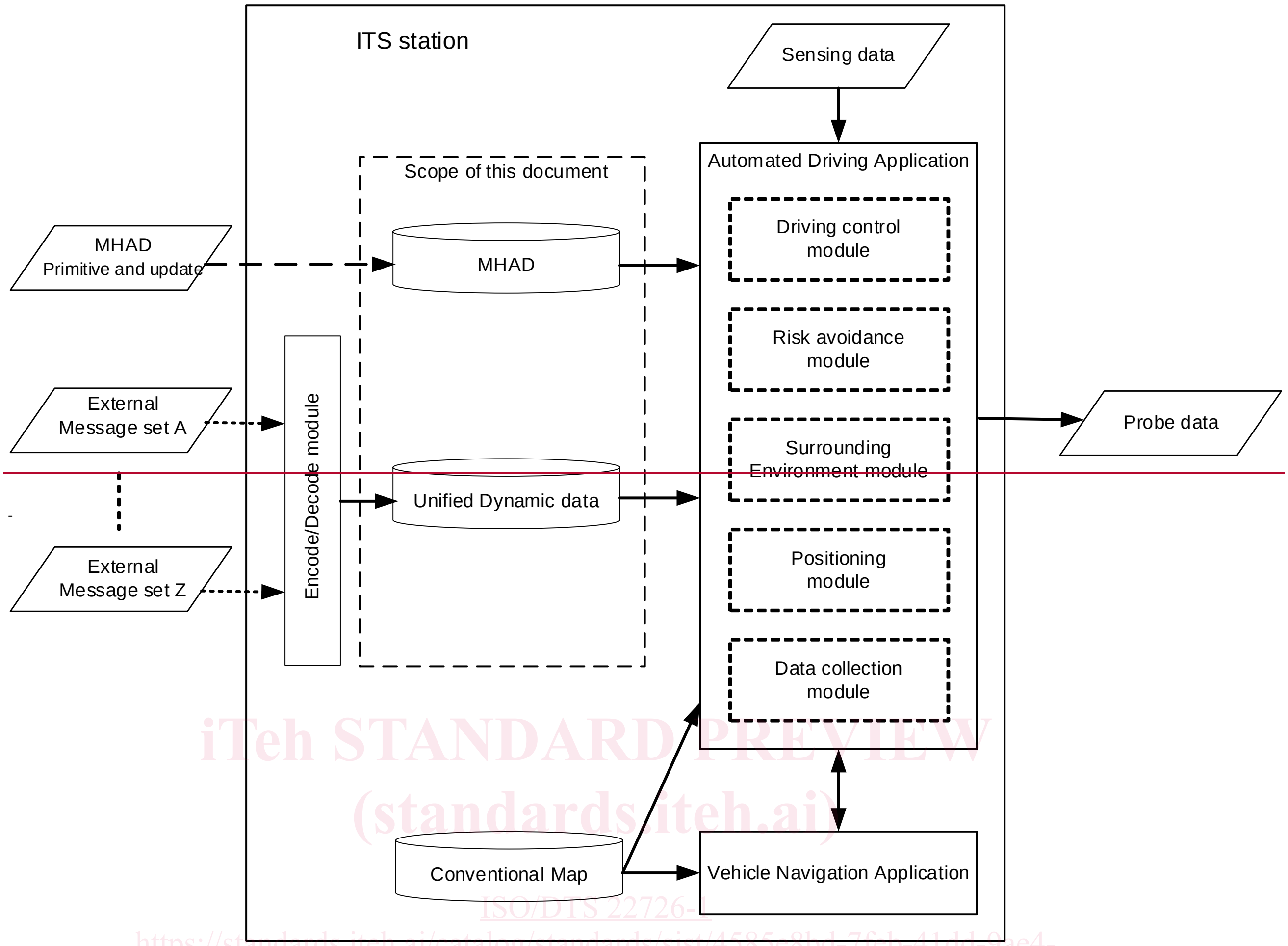
Throughout this document, the data types and stereotypes as defined in Table B.1 apply.

6 Architecture

Automated ~~Driving Systems~~driving systems (ADSs) and their applications can refer to both static map data and dynamic information data. In addition, ITS stations in automated driving vehicles, connected vehicles and road equipment can collect sensing data, such as contradictions between the static map and features of the real world, traffic data, and travel information, and distribute them as probe data.

Figure 1 depicts the conceptual system architecture of map data in an ITS station for ~~automated driving system.~~ an ADS.

In ITS vehicle stations that correspond ~~with automated driving systems~~to ADSs, the application uses map data (MHAD) and additional dynamic data. The original data, along with updates of the MHAD data~~,~~ and dynamic data, are intended to be provided through external transmitted messages received from outside of the station. Automated driving applications also use data collected from both in-vehicle and roadside mounted sensors and can also use conventional map data which complements the applications ~~that~~to which the navigation system and/or C-ITS refer ~~to~~.


ITS station
Sensing data
Automated Driving Application
Scope of this document
MHAD
Primitive and update
MHAD
Driving control module
Risk avoidance module
External Message set A
Encode/Decode module
Probe data
Surrounding Environment module
Unified Dynamic data
Positioning module
External Message set Z
Data collection module
Conventional Map
Vehicle Navigation Application