BS ISO 14296:2016

BSI Standards Publication

Intelligent transport systems — Extension of map database specifications for applications of cooperative ITS

bsi.

...making excellence a habit.™

Document Sharing Hub

National foreword

This British Standard is the UK implementation of ISO 14296:2016.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Intelligent transport systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.
Published by BSI Standards Limited 2016

ISBN 978 0 580 84000 5

ICS 03.220.01; 35.240.60

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2016.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 14296:2016

INTERNATIONAL STANDARD

ISO 14296

First edition
2016-02-15

Intelligent transport systems — Extension of map database specifications for applications of cooperative ITS

Systèmes intelligents de transport — Extension des spécifications de base de données cartographiques aux applications collaboratives des SIT

Reference number
ISO 14296:2016(E)

Documents
Document Sharing Hub

© ISO 2016

Full document details: BS ISO 14296:2016

COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 14296:2016

Contents

Page

Foreword ... **v**
Introduction ... **vi**
1 Scope ... **1**
2 Normative references ... **1**
3 Conformance ... **1**
4 Terms and definitions ... **1**
5 Symbols and abbreviated terms ... **5**
6 Requirements ... **5**
6.1 Introduction ... 5
6.2 Application requirements ... 5
6.3 Functional requirements ... 5
6.3.1 Overview ... 5
6.3.2 Map Display ... 6
6.3.3 Positioning ... 7
6.3.4 Route Planning ... 8
6.3.5 Route Guidance ... 10
6.3.6 Service and POI Information Access ... 12
6.3.7 Address Location ... 13
6.3.8 Cooperative ITS support (including driving support) ... 13
6.3.9 Multi-Modal Travel Support ... 14
6.3.10 Update ... 15
6.3.11 System performance ... 15
7 Logical data model ... **16**
7.1 Overall model ... 16
7.1.1 General ... 16
7.2 Transportation package ... 16
7.2.1 Overview ... 16
7.2.2 Road network package ... 18
7.2.3 Transfer zone network package ... 45
7.2.4 Public transportation network ... 46
7.2.5 Pedestrian path network ... 46
7.2.6 Bicycle path network ... 46
7.3 Cartographic package ... 47
7.3.1 Overview ... 47
7.3.2 Background package ... 47
7.3.3 Graphic text package ... 51
7.4 Service and POI package ... 52
7.4.1 General ... 52
7.5 Address Location package ... 53
7.5.1 General ... 53
7.6 Dynamic information package ... 55
7.7 Relationship of the road data between levels ... 56
7.7.1 General ... 56
7.7.2 Relation of the Intersection and Intersection Connecting Point between levels ... 56
7.7.3 Relation of the Road Elements between levels ... 57
7.7.4 Example for Road Element, Intersection Connecting Point and Intersection between levels ... 57
Annex A (normative) **Abstract test suite** ... **59**
Annex B (informative) **Description of UML expression elements** ... **60**
Annex C (normative) **Basic set of applications definition** ... **62**

AVA Documents
Document Sharing Hub

© ISO 2016 – All rights reserved

Full document details: BS ISO 14296:2016

Annex D (informative) **Overview of examples of targeted (Japanese examples) driving support services** **63**

Annex E (informative) **Relationship between basic set of applications and driving support services (Japanese example)** **80**

Annex F (informative) **Use case of Multi-Modal Travel Support service** **81**

Bibliography **88**

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

Introduction

The purpose of this International Standard 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 International Standard 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.

In order to meet the schedule requirements of Mandate M/453 "Standardisation mandate addressed to CEN, CENELEC and ETSI in the field of Information and Communication Technologies to support the interoperability of Co-operative systems for Intelligent Transport in the European Community" issued by the European Commission, ISO/TS 17931 was published as the Local Dynamic Map component of this International Standard.

This International Standard includes all of the contents of ISO/TS 17931.

This International Standard defines the Logical Data Model for Multi-Modal navigation system. It does not define the data model for individual navigation service except for in-vehicle navigation.

This International Standard 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.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

INTERNATIONAL STANDARD ISO 14296:2016(E)

Intelligent transport systems — Extension of map database specifications for applications of cooperative ITS

1 Scope

This International Standard provides the map-related functional requirements, data model (logical data model/logical data organization), and data elements for those applications of cooperative ITS that require information derived from map databases.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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/IEC 19501:2005, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

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*

3 Conformance

Data structures shall be provided as specified in Clause 7.

Any data structure claiming conformance with this International Standard shall pass the requirements presented in the abstract test suite in Annex A.

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

4 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 14825 and ISO/TS 20452 and the following 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

4.2
application category
basic sub-function within the set of functionality for cooperative ITS support

Note 1 to entry: This International Standard identifies eight application categories: Positioning, Route Planning, Route Guidance, Map Display, Address Location, Services and POI Information Access, cooperative ITS including Driving support, Multi-Modal Travel.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

4.3
display point
0-dimensional type of cartographic feature

4.4
geocoding
determination of a link or node based on address information describing and/or naming a location

4.5
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

4.6
itinerary
plan of a journey, including the route and the places visited

4.7
junction
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

4.8
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.

4.9
layer
sub-set of map data resulting from a subdivision of data of the same coverage area based on contents (similar to ISO 14825 GDF layer) and which is typically related to one or only a few of the application categories

EXAMPLE District name, which is one of the data items for Route Guidance applications, is included in a layer.

4.10
level
sub-set of map data resulting from classification of data of the same semantic 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.

4.11
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

4.12
Local Dynamic Map
conceptual data store which is embedded in an ITS station and which contains topographical, positional and status information

4.13
Map Display
application category that deals with graphical information presentation

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

4.14
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

4.15
Multi-Modal Travel Service
application category that provides information on a trip from an origin to a destination using alternative modes of transportation or a combination of transport modes for one trip

Note 1 to entry: This service may include navigation.

4.16
Multi-Modal Travel Support
application function for Multi-Modal Travel Service

4.17
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.

4.18
place
named area which can be used as part of Address Location

4.19
Point of Interest
POI
destination and/or site of interest to travellers, usually non-commercial by nature

4.20
polygon
2-dimensional type of cartographic feature

4.21
polyline
1-dimensional type of cartographic feature

4.22
Positioning
application category that deals with the determination of vehicle location and map-matching

4.23
position-on-the-link
position on the road or road side used to identify the access point between the road network and entrance or exit of facilities such as station, bus stop and building

4.24
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

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

4.25
regular parcel
parcel shaped like a rectangle

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

4.26
reverse geocoding
determination of the address description of a link or node (i.e. determination of an upwards path across the place tree)

4.27
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

4.28
route
ordered list of route links, or of stop points respectively, defining a single path through the transport network, with a direction

4.29
Route Guidance
application category that deals with the generation of graphical, textual, and/or audio instructions for following a planned route

4.30
route link
oriented link between two route Points defining a unique path through the transport network

4.31
Route Planning
application category that deals with the determination of routes between specified points

4.32
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

4.33
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) or place(s), by which it can be accessed

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.

4.34
Service and POI Information Access
application category that deals with the provision of POI information to the navigation application

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

4.35
shape point
position along a link used to more accurately represent its geometric course, bounded by exactly two segments

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

4.36
stop point
position where passengers get in or off a (public transport) vehicle

4.37
symbol
icon associated with a cartographic feature

5 Symbols and abbreviated terms

ADAS	Advanced Driver Assistance System
BSA	Basic set of applications
DB	Database
GDF	Geographic Data File
ITS	Intelligent Transport System
ITS-RSU	Intelligent Transport System - Road Side Unit
LDM	Local Dynamic Map
LDO	Logical Data Organization
POI	Point of Interest
PSF	Physical Storage Format

6 Requirements

6.1 Introduction

This clause defines application requirements and functional requirements.

6.2 Application requirements

This International Standard supports BSA of cooperative ITS systems, Driving support services, and navigation services for in-vehicle and Multi-Modal Travel.

BSA of cooperative ITS systems are defined in Annex C. Driving support services are defined in Annex D. The relationship between BSA of cooperative ITS systems and driving support services are defined in Annex E and Multi-Modal Travel services are defined in Annex F.

6.3 Functional requirements

6.3.1 Overview

Six application categories (Map Display, Positioning, Route Planning, Route Guidance, Service/POI Information Access and Address Location) for navigation functionality are the same as those defined in ISO/TS 20452:2007. Cooperative ITS (including driving support) and Multi-Modal Travel Support functions are newly defined by this International Standard.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

6.3.2 Map Display

6.3.2.1 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).

6.3.2.2 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 are also selectable by level.

6.3.2.3 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.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

— R-12. displays a map at the current location of the navigation system;

— R-13. displays a marker on the map indicating the navigation system's current location;

— R-14. scrolls the displayed map as the navigation system moves, maintaining the position of the marker indicating the navigation system's current location;

— R-15. displays 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. provides latitude and longitude, street address, and other information for a point indicated by the cursor on the display;

— R-17. highlights a route on the display;

— R-18. highlights the point on a displayed map of a particular routing manoeuvre.

— 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.

6.3.3 Positioning

6.3.3.1 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 system has moved in the road network based on the navigation system's previous location and data about the navigation system's motion from external inputs. It corrects the geo-localization on the routes.

6.3.3.2 Functional description

"Positioning" seeks a position and orientation of a navigation system relative to the transportation network with respect to the map data representing the real world. An application may dynamically determine the navigation system's current position while the navigation system is in motion. Map Matching can continue "in the background" even while other functions are being performed so the navigation system always "knows where it is", with an accuracy depending on the map-matching. Map Matching algorithms are beyond the scope of this document.

6.3.3.3 Requirements for data model

For the purpose of Positioning, the following functions shall be provided:

— R-25. a single set of coordinates for an application-specified Point Feature in the Roads and Ferries theme;

— R-26. the set of Edges, Nodes and/or Intermediate Points for an application-specified Feature or set of connected Features in the Roads and Ferries theme;

— R-27. the set of topologically connected Features in the Roads and Ferries Theme connected to an application specified Feature in the Roads and Ferries theme;

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

— R-28. a single set of coordinates for an application-specified Line Feature in the Roads and Ferries theme and application-specified percentage of the distance along the Feature;

— R-29. the set of Features, Edges, Nodes and/or Intermediate Points in the Roads and Ferries theme within an application-specified rectangle;

— R-30. Positioning related Attributes, Conditions and Relationships (i.e. Prohibited Manoeuvres, Direction of Traffic Flow) for an application-specified Feature in the Roads and Ferries theme;

— R-31. the entry and exit angles for the set of Transportation Elements connected to an application-specified Intersection or junction;

— R-32. this International Standard shall support a single, world-wide, latitude/longitude-based coordinate reference system. The International Terrestrial Reference Frame (ITRF) is chosen because it is maintained by an international body. It is considered equivalent to WGS84 because the two systems currently have less than 1 m difference;

— R-33. only one coordinate system can be used in a single piece of storage media;

— R-34. when an application tracks progress along the route and provides manoeuvre instructions at appropriate points to the end-user;

— R-35. when an application determines whether the navigation system has left the planned route;

— R-36. when an application calculates a route to the requested destination from the navigation system's current position;

— R-37. when an application scrolls the displayed map;

— R-38. when an application selects services by geographic proximity;

— R-39. when an application is displaying the navigation system's position on a map;

— R-40. when an application displays a map around a location relative to the navigation system's current position;

— R-41. Positioning may receive planned route information from the Route Planning application for use in Map Matching.

— R-42. Only access to the lowest level of data are required.

— R-43. Only access to the data represented in the Roads and Ferries theme is required.

— R-44. Positioning data shall be organized into parcels.

— R-45. 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.

— R-46. In order to allow fast spatial access to parcels, parcels shall be accessed by their bounding rectangles. The shapes of parcels on the lowest level shall not overlap.

6.3.4 Route Planning

6.3.4.1 General description

The Route Planning function is used to determine routes from one user-specified location to another.

6.3.4.2 Functional description

Navigation applications may calculate routes based on attributes of the transportation network. Applications may allow end-users to specify criteria for the route such as "shortest distance", "no highways", etc. As a basic operation, a user indicates a departure position, which could be the navigation

© ISO 2016 – All rights reserved
AVA Documents Document Sharing Hub
Full document details: BS ISO 14296:2016

system's current position, and selects a destination (place to go) and possibly one or more waypoints. A suitable route is then calculated. Route Planning is not limited to automobile transportation only. This function supports routing via any mode represented in the database. This may include rail and water ferries, taxis, and routes only accessible by bicycle or foot. Other forms of public transportation may be considered in the future.

The route calculation algorithms are outside the scope of this functional description.

To improve data access speed, the Logical Data Organization groups transportation features into levels. The higher levels contain only the more significant features (e.g. highways and main roads). These may be aggregated. Correspondences between features at different levels shall be made available to the application. The functions specified in the requirements below allow selection by level.

6.3.4.3 Requirements for data model

The Route Planning application provides the following methods of accessing data that can be used for routing:

— R-47. via the set of topologically connected *Links* for an application-specified Link at an application-specified level;

— R-48. via routing-related attributes for an application-specified Transportation Element or set of connected Transportation Elements, such as: node coordinates (of the bounding nodes of a link), measured length, functional road class, number of lanes, average speed, divided Road Element, form of way, as well as access characteristics, conditions, and other relationships;

— R-49. via navigation attributes for roads and intersections;

— R-50. via corresponding link for an application-specified link at an application-specified different level;

— R-51. via a set of topologically connected GDF roads for an application specified GDF road at an application specified level at certain levels to be determined;

— R-52. via a set of GDF Road Elements and GDF junctions, which comprise a GDF road or GDF intersection;

— R-53. via the GDF road or GDF intersection for an application-specified GDF road element or GDF junction;

— R-54. via the corresponding entity representing a GDF junction or Intersection for an application-specified entity representing a GDF junction or intersection at an application-specified different level;

— R-55. via effective time or date periods for turn, travel, or other conditions;

— R-56. via location references which are stored in the database for an application-specified set of transportation elements;

— R-57. via a set of transportation elements for an application-specified location reference which is stored in the database;

— R-58. via the entry and exit angles for the set of links connected to an application-specified Intersection or junction;

— R-59. via historic and forecast traffic conditions, incidents, and events information for a specified transportation element or set of transportation elements;

— R-60. via a DAL capable of providing transparent access to static and dynamic traffic information. It shall not preclude or require the integration of dynamic traffic information from external systems;

— R-61. via an API allowing a pre-fetch area of interest specified by feature ID or rectangle for retrieving Route Planning data at an application-specified level.

Documents
Document Sharing Hub

© ISO 2016 – All rights reserved

Full document details: BS ISO 14296:2016

— R-62. the Route Planning application accepts other information from the Positioning application when calculating a route to the requested destination from the navigation system's current position.

— R-63. the Route Planning application provides information about the planned route to the Positioning application when determining whether the navigation system has left the planned route.

— R-64. the Route Planning application provides information about the planned route to the Route Guidance application for generating driving instructions.

— R-65. the Route Planning application provides information about the planned route to the Services and POI Information Access application for geographic selection of services with proximity to the planned route.

— R-66. the Route Planning application accepts input from the Services and POI Information Access and Address Location application when determining end-points or way-points for a route.

— R-67. the Route Planning application provides information about the planned route to the Map Display Application when indicating the course of the planned route on the graphical Map Display.

— R-68. Only access to the data represented in the roads and ferries theme is required. Enclosed traffic areas shall be represented by links and nodes.

— R-69. the shape of a parcel on a given level shall be contained in the shape of exactly one parcel at a higher level. The shapes of parcels on the same level shall not overlap.

— R-70. For Route Planning data, references to parcels on the same level and on the level(s) above and below are required.

— R-71. In order to have optimally filled parcels, parcels may have different coverage sizes.

— R-72. For Route Planning data, no intermediate points are required for the representation of links. A representation of turn angles, link length and the link cost are required.

— R-73. There is no requirement to create an additional node where a link crosses a parcel boundary.

— R-74. For Route Planning data, links crossing a parcel boundary should be stored as a whole in those parcels where they are connected to other links in the same parcel.

— R-75. In order to have fast access to parcels, parcels shall be accessed by their bounding rectangles.

— R-76. A separate computation is required to find nodes or links in the network data corresponding to origin, intermediate and destination points. The manner in which the nodes or links are found is outside the scope of this International Standard.

6.3.5 Route Guidance

6.3.5.1 General description

The Route Guidance function is used to generate instructions for following a route.

6.3.5.2 Functional description

The Route Guidance function generates step-by-step instructions for following a route. These instructions may include compass heading, distance, road names, sign text, landmarks, and still or motion images. These instructions may also include manoeuvre details such as turn angle, merges, and road name changes. Route Guidance may be given using text, voice or graphics.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

6.3.5.3 Requirements for data model

Route Guidance provides the following methods of accessing data used for guidance of a route:

— R-77. via guidance-relevant features and relationships related to an application-specified transportation element, or set of transportation elements, such as: intersecting Road Elements, signpost Information, conditions and landmarks along the transportation element;

— R-78. via guidance attributes for an application-specified transportation element, or set of transportation elements, such as: road names, length, direction of traffic flow, and form of way;

— R-79. via indicating whether an application-specified junction is a part or all of an Intersection;

— R-80. via indicating whether an application-specified link is a regular link, a super link or part of a super link;

— R-81. via connected transportation elements for an application-specified junction;

— R-82. via connected transportation elements for an application-specified Intersection which are not part of that Intersection, such as the set of Road Elements connected to a roundabout;

— R-83. via component transportation elements of an application-specified Intersection, such as the set of Road Elements and junctions which make up a roundabout;

— R-84. via data about the transition from an application-specified link to an application-specified series of connected links, such as: the existence of a tollbooth or gate;

— R-85. via node and intermediate point positions for line features to support displaying manoeuvre "arrows" for Route Guidance;

— R-86. via cartographic data for the line features comprising an Intersection for the derivation of intersection schematics;

— R-87. via entry and exit angles for the set of transportation elements connected to an application-specified intersection or junction;

— R-88. via phonetic strings in an application-specified language for pronunciation of any named entity in the database;

— R-89. via phonetic strings in an application-specified language for commonly used guidance words;

— R-90. via digitized pronunciation data in an application-specified language for commonly used guidance words;

— R-91. via API allowing a prefect area of interest specified by a rectangle for retrieving Route Guidance data;

— R-92. via image data for optional picture guidance;

— R-93. provides guidance while the navigation system is in motion, based on a calculated route and map matching;

— R-94. tracks progress along the route and provide manoeuvre instructions at appropriate points to the end-user;

— R-95. Route Guidance data shall be organized into parcels;

— R-96. In order to allow fast access to parcels, parcels shall be accessed by their bounding rectangles;

— R-97. In order to have optimally filled parcels, parcels may have different coverage area sizes.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

6.3.6 Service and POI Information Access

6.3.6.1 General description

The Service and Points-of-Interest (POI) Information Access function provides access to data which are commonly used as origins or destinations for a route and which contain information useful to travellers. Services are single point or area locations that are typically known by name rather than address. Services include traveller-related commercial services such as hotels, restaurants, and gas stations. Services also include locations or points of interest to travellers, such as national parks, monuments, and tourist attractions. Services can be categorized by type (e.g. airport, city centre, and hotel) and may carry a variety of other attribute information (e.g. rating, cuisine type, credit cards accepted).

Typically, third party organizations, such as tourist or motoring organizations, can offer a rich content of traveller information which may be of interest to the user. This type of service information is called Third Party Data (TPD). The amount of service information supplied by Third Parties may vary and may consist of comprehensive service data, including locational aspects and a linkage to the road network. Some TPD may originate from a party which has imposed proprietary restrictions on the use of the data. This is a subset referred to as Branded Third Party Data (BTPD) which imposes additional requirements.

6.3.6.2 Functional description

An application may provide service data to the end-user. Also, an application may allow the use of services in Address Location, Route Planning, and Map Display. An application may provide information about services, including TPD. The services may be selectable by types, geographic areas (e.g. within a rectangle or within distance of a point), places (e.g. Administrative areas, Districts, Postal areas), service attributes, or whether the service is associated with TPD. Services may be associated with Road Elements or other components of the Transportation Network based on their location. This provides a location on a Road Element which gives access to a service.

Additionally, searches for services may be qualified by an application-specified partial or full spelling match to the beginning of the service type, attribute, name, or to any individual word within the type, attribute or name.

Services may be associated with each other. A primary service is called a parent. A parent service may have many secondary services called child services. A child service may also have many parent services. One example of how this relationship is used is in the definition of an airport service that has multiple parking lots. In this case, the airport is designated as the parent service and the parking lots are designated as children of that parent.

A Service may be associated with multiple places. For example, the Dallas/Fort Worth Airport is physically located in Arlington and Grapevine. It is also logically associated with Dallas and Fort Worth.

Service and POI Information Access shall support different entry orders by means of appropriate data structures. Typically, a hierarchical top-down entry order may be used. However, permutations thereof shall also be supported, e.g. POI brand name first.

Service and POI Information Access shall support extensions to the search criteria when no match is found. The user may demand an expanded search area, i.e. areas close to the specified place(s) or spelling tolerance for similarly pronounced/written names.

6.3.6.3 Requirements for data model

Service data may be accessed by the following methods:

— R-98. via service attribute data for an application-specified service (to the extent they exist in the database) for example: name, address, phone number, chain, facility type, and days and times the service is open;

— R-99. via the coordinates of an application-specified service;

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

— R-100. via the related Road Elements and position along the Road Elements for the entry to an application-specified service;

— R-101. via the related services of an application-specified Road Element;

— R-102. via the set of services within an application-specified set of places;

— R-103. via the set of services within an application-specified set of rectangles;

— R-104. via the set of services where an application-specified partial or full spelling matches the beginning of the service name.

6.3.7 Address Location

6.3.7.1 General description

This function is used to access data that are used to determine positions, both on the earth and in the map data representation of the earth.

6.3.7.2 Functional description

Address Location is the determination of a location based on information describing or naming the location. An application may determine locations based on various types of information. For example, this information can be an address or cross-streets. There are also two basic methods of Address Location:

Geocoding: determining a link or a node, or a polygon or representative point by its address description.

Reverse geocoding: determining an address description of a link or node or representative point or area.

End users or applications may not know the complete standard of a location. For example, they may not know the complete address and administrative area, or they may not know whether a street is a "street" or an "avenue". They may need to search the database based on the information they do know, and examine a set of locations matching their criteria.

Address Location may support different entry orders by means of appropriate data structures. Typically, a hierarchical top-down entry order may be used. However, permutations thereof shall be supported (e.g. street name first).

Address Location may support extensions to the search criteria when no match is found. The user may demand an expanded search area (e.g. areas close to the specified place(s) or spelling tolerance for similarly pronounced/written names).

6.3.7.3 Requirements for data model

The following requirements may apply to data model:

— R-105. Determination of a location may be based on information describing or naming the location;

— R-106. An application may determine locations based on various types of information. For example, this information can be an address or cross-streets;

— R-107. There are also two basic methods of Address Location.

6.3.8 Cooperative ITS support (including driving support)

6.3.8.1 General description

This function is used to provide information for supporting cooperative ITS and safe driving.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

6.3.8.2 Requirements for data model

The following requirements may apply to data model:

— R-108. Advisory information on intersection and road may be provided to a driver;

— R-109. Road Signage information on intersection and road may be provided to a driver;

— R-110. Detailed road segment information around the vehicle may be provided to a driver;

EXAMPLE Lane, Lane Shape, Surface shape of Intersection, Surface shape of Road Element and Road Marking.

— R-111. The location information provided by an external system such as RDS-TMC shall be translated into road object location or place object location.

— R-112. Cautionary information on intersection or road may be provided to a driver and cooperative ITS applications;

— R-113. Traffic Signal information on intersection or road may be provided to a driver and cooperative ITS applications;

— R-114. The relation between traffic signal and lane may be provided to a driver and cooperative ITS applications;

— R-115. Coverage, accuracy and freshness of data may be maintained to be consistent with the policy of Driving Support services.

6.3.9 Multi-Modal Travel Support

6.3.9.1 General description

Multi-Modal Travel Support function consists of seven sub functions: Positioning, Map Display, Multi-Modal Route Planning, Multi-Modal Route Guidance, Service and POI Information Access, Address Location and Travel information access and provision.

6.3.9.2 Functional description

Positioning sub function has some small differences in comparison with the function that is described in 6.3.3. Positioning sub function provides the position of the traveller to the Multi-Modal Travel Support application and other six sub functions.

Positioning sub function for the Multi-Modal Travel Support application may be supported by Positioning functions of the navigation application for car, public transportation, bicycle and pedestrian.

In addition, the position of the traveller may be provided by the information from an external Positioning system such as GPS, position server, etc. Positioning sub function has an interface to external Positioning system optionally.

Map Display sub function for Multi-Modal Travel Support application is the same function that is described in 6.3.2.

The Multi-Modal Route Planning sub function for Multi-Modal Travel Support application is slightly different from the function described in 6.3.4. The Route Planning function provides a route between two locations serviced by a single transport mode. The Multi-Modal Route Planning sub-function combines the routes of the different transport modes integrating transfers and provides the itinerary. The itinerary may contain transfer locations, timing information, transport mode etc. Of course the Multi-Modal Travel Support application may use some Route Planning functions for car, public transportation, bicycle and pedestrian.

The Multi-Modal Route Guidance sub function for Multi-Modal Travel Support application is slightly different from the function that is described in 6.3.5. The Route Guidance function provides the Route

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

Guidance for trips using a single transport mode. The Multi-Modal Route Guidance sub function combines the Route Guidance for different trips, each one using a single transport mode and provides the Route Guidance through the transfer to the traveller.

The Service and POI Information Access sub function for Multi-Modal Travel Support application is the same function that is described in the 6.3.6.

The Address Location sub function for Multi-Modal Travel Support application is the same function that is described in 6.3.7.

The travel information access and provision sub function for Multi-Modal Travel Support function gathers respective travel information for a single mode in accordance with the traveller's order or application's order.

6.3.9.3 Requirement for data model

The following requirements shall apply to the data model:

— R-116. Road network shall contain the connection data for transferring between transport modes;

— R-117. the schedule of a segment of the route (e.g. time-table of public transportation) shall be provided;

— R-118. the entire route generated by Multi-Modal Route Planning may be displayed as a set of shapes;

— R-119. the entire itinerary may be provided by the textual list;

— R-120. the guidance data for the navigation path through the transfer shall be provided.

6.3.10 Update

6.3.10.1 General description

Update is general function for maintaining the data elements that is used by the above functions.

6.3.10.2 Requirement for data model

The following requirements for Update shall apply to the data model:

— R-121. Updating data element shall be possible (addition, correction, and deletion);

— R-122. The addition of the new data entity in the future shall be possible;

— R-123. Data structure shall receive the minimum influence by updates;

— R-124. Updating Intersection information on the boundary of parcel shall be possible;

— R-125. Updating protocols and data structures shall be achieved by ISO 24099.

6.3.11 System performance

6.3.11.1 General description

System performance refers to the impact of data structure and data model on how well a cooperative ITS system will perform.

6.3.11.2 Requirement for data model

The following requirements for system performance shall apply to data model:

— R-126. It shall be possible for data structure to comply with ISO 17267.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

— R-127. It shall be possible for data structure to adopt both Relational DB and Navigable DB.

7 Logical data model

7.1 Overall model

7.1.1 General

The overall model expresses the static map data for ITS services, and relation between map data and the dynamic external information for ITS.

The overall model as shown in Figure 1 presents the relation between the following data model packages.

This overall model is based on ISO/TS 20452. It consists of the following packages:

— Transportation package;

— Cartographic package;

— Address Location package;

— Service and POI package;

— Dynamic Information package.

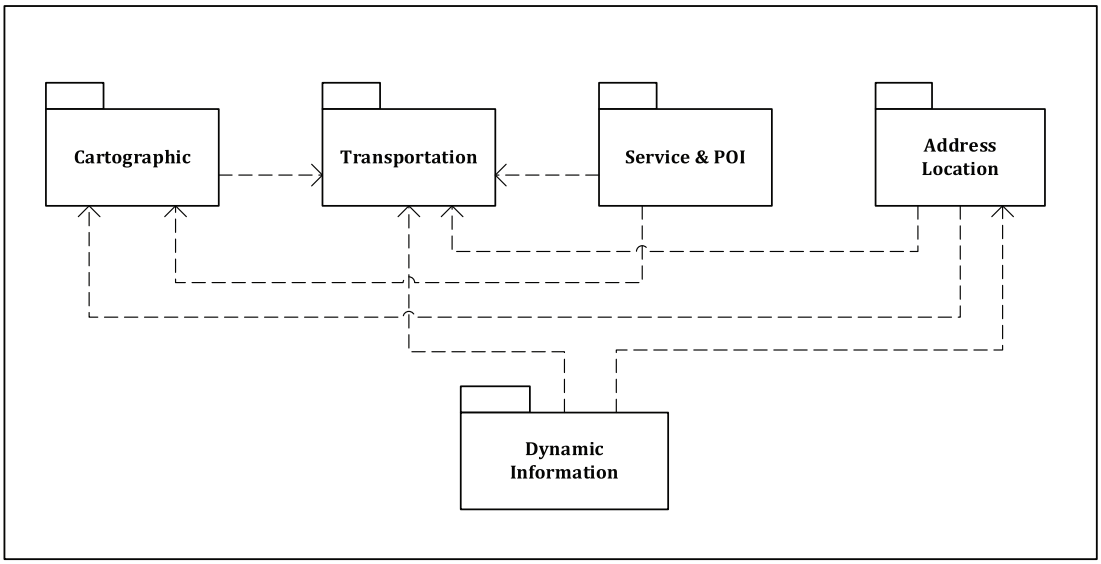

Figure 1 — Overall model

NOTE Some data objects that are defined in this International Standard may have a geometric description (shape information) and coordinates. The definition of coordinate system is out of the scope of this International Standard.

7.2 Transportation package

7.2.1 Overview

Transportation package defines the network data objects for ITS services which are cooperative ITS service supported by LDM, the Multi-Modal Travel Support service, car navigation, public transportation service, bicycle navigation and pedestrian navigation.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

Transportation package consists of five packages: Transfer Zone Network package, road Network package, Public Transportation Network package, Bicycle Path Network package and Pedestrian Path Network package.

It assumes that Multi-Modal Travel Support services will be supported by expanding the application and data model of existing services such as car navigation, Public Transportation Travel service, Bicycle navigation and Pedestrian navigation. And it assumes that cooperative ITS application used Local Dynamic Map will be supported by Road Network package.

Transfer Zone Network is used for transferring, Road Network is used for cooperative ITS application (e.g. LDM application includes car navigation), Public Transportation Network is used for Public Transportation applications, Bicycle Path Network is used for Bicycle navigation and Pedestrian Path Network is used for Pedestrian navigation.

The scope specifies how to transfer between the road network and public transportation network but not between one public transportation mode and another public transportation mode. Transfer between public transportation modes is specified in ISO 19132.

Transfer Zone Network package defines the relation between Transportation networks: Road Network, Public Transportation Network, Bicycle Path Network and Pedestrian Path Network for Multi Modal Travel services.

This International Standard defines the detail of Road Network data for providing road data to target application.

However, this International Standard does not define the detail of Public Transportation Network, Pedestrian Path Network and Bicycle Path Network.

Figure 2 below illustrates the Transportation package.

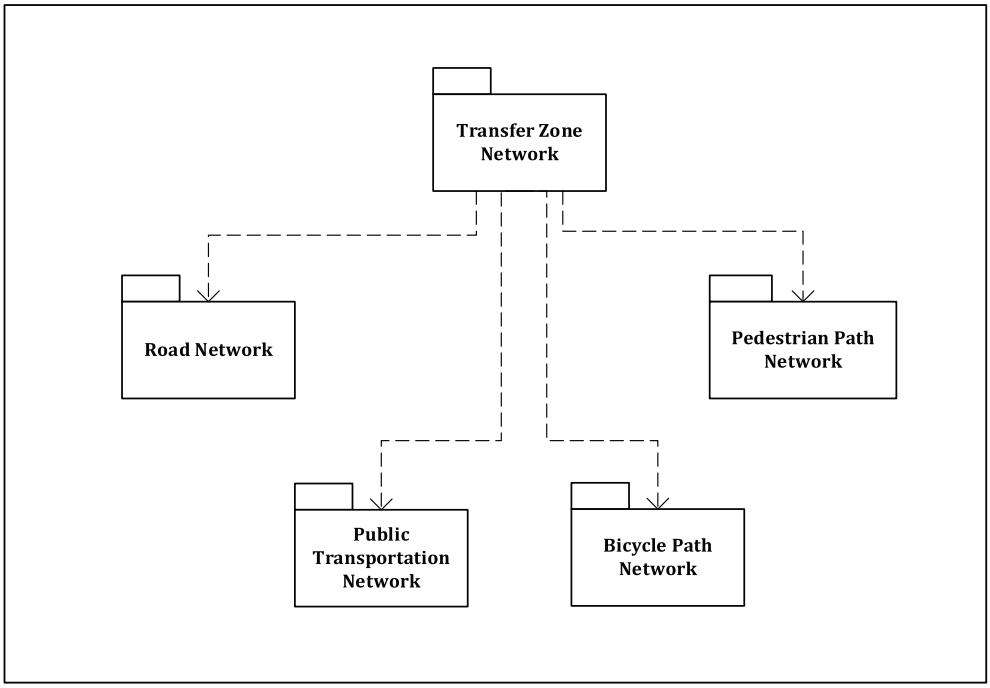

Figure 2 — Transportation package

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

7.2.2 Road network package

7.2.2.1 Overview

Road Network package defines the static road data for cooperative ITS application. There are a variable number of data levels in road network, and there are relations between the levels.

Road Network package consists of three sub packages: Road Network Object, Topological Road Network and Intersection and Road Element Guidance shown in Figure 3.

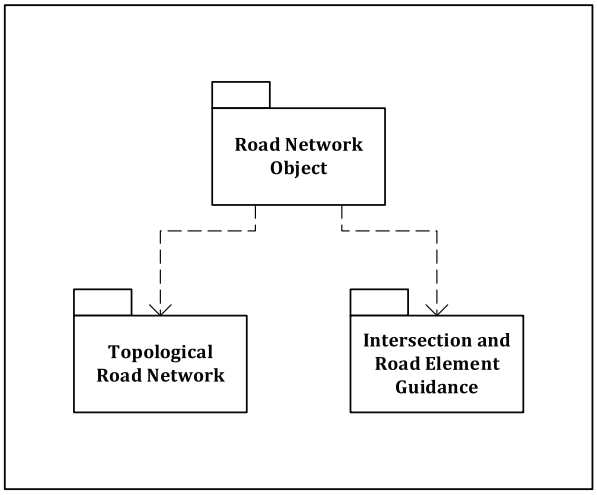

Figure 3 — Road network package

7.2.2.2 Road network object package

7.2.2.2.1 Overview

Road Network Object package defines the data structure and characteristics of the road.

Road Network Object package consists of 14 entities: Road Object, Road Section, Road Element, Intersection Connection Point, Intersection, Road Element Shape, Intersection Link, Intersection Link Shape, Lane, Lane Shape, Road Marking, Road Structure Change Point, Advisory Point/Section and Traffic Signal as shown in Figure 4.

Road Element Shape, Lane Shape, Intersection Link Shape and Road Marking in Road Network Object package contain the geometric information.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

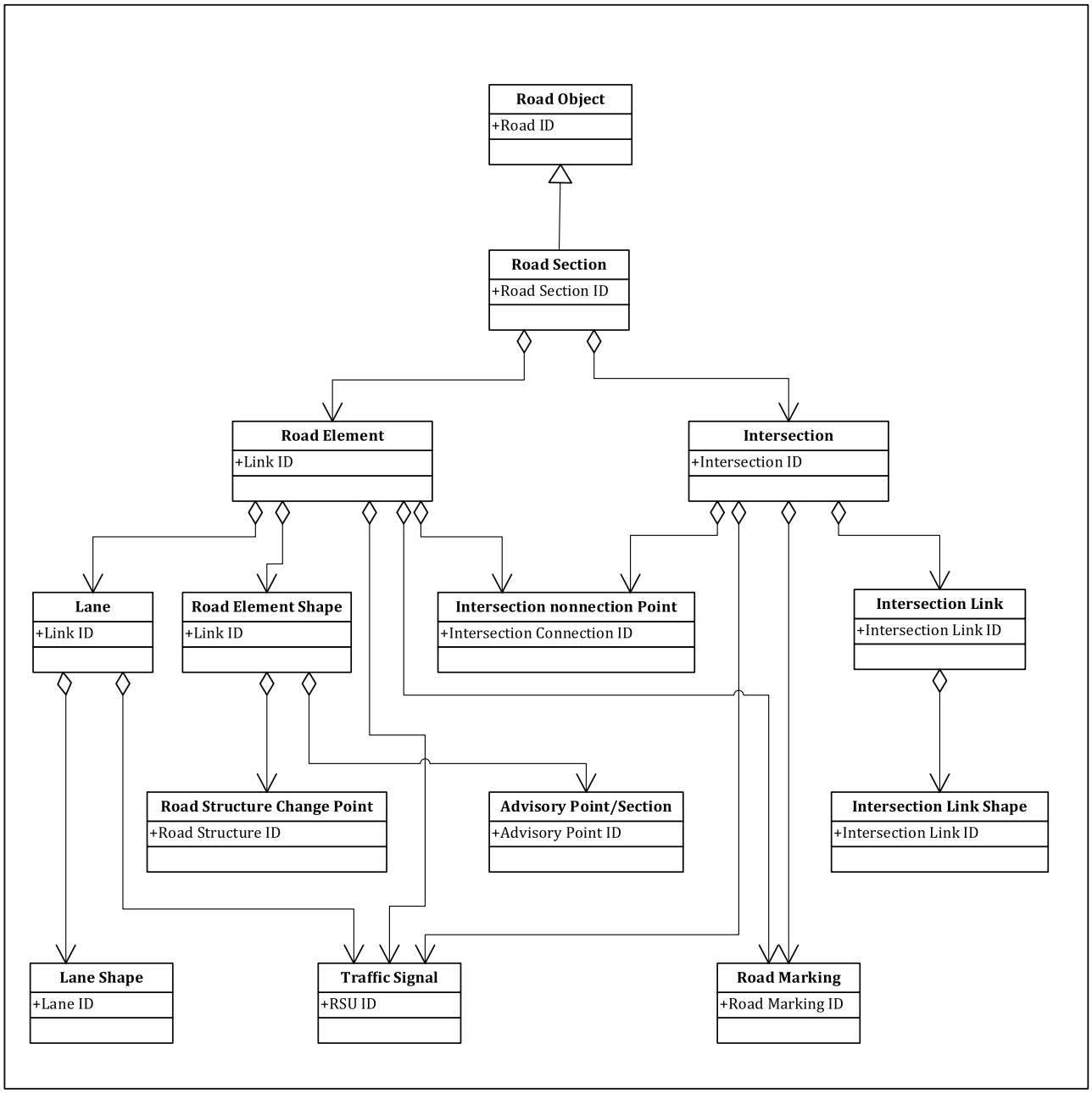

Figure 4 — Road network object package

7.2.2.2.2 Road object

7.2.2.2.2.1 Definition of road data

Road Object is a root entity of the Road Network Object package.

Road Object is a passable area which is called a street / roadway in specific parcel.

Each Road Object is an aggregation of Road Sections as shown in Figure 4.

7.2.2.2.2.2 Data elements of road object

Road Object is specified by Road ID.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

Table 1 lists data elements of Road Object.

Table 1 — Data elements of road object

Data Element / Attribute	Note
Road ID	
number of Road Section	
road class	
road route number	it is set by road operator
road identifier code	it is set by road operator

7.2.2.2.3 Road section

7.2.2.2.3.1 Definition of road section

Road Section is a serial aggregation of Road Elements and Intersections.

Each Road Section consists of one or more Road Elements and two or more Intersections, and both ends of Road Section are Intersections.

If a Road Object has two carriage ways which are expressed by double Line as shown in Figure 5, each carriage way shall be defined by respective Road Sections.

Road Section is associated with Road Object and Road Section associates with Road Element and Intersection.

The Road Section shall not include any Road Element that composes other Road Section in the same data level.

NOTE Expression of the Road Section is the same as used the Multilink of ISO/TS 20452, except the intersection part. For example in Figure 5, when the constitution of the road changes from double line to single line, two Road Sections are set as Road Section A and B. Road Section B and part of the double line of Road Section A may be aggregated to the single lined Road Section in the upper level.

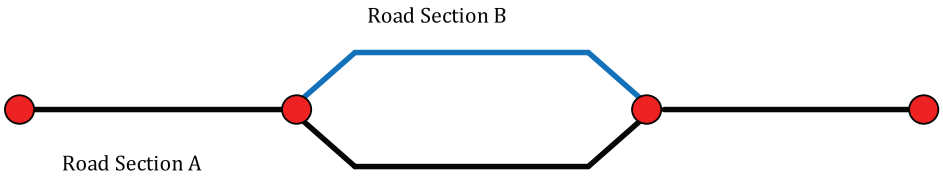

Figure 5 — Road section

7.2.2.2.3.2 Data elements of road section

Road Section is specified by Road Section ID.

Table 2 lists data elements of Road Section.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016

Table 2 — Data elements of road section

Data Element / Attribute	Note
Road ID	
Road Section ID	
road route number	
road identifier code	
number of Intersection in this Road Section	
start Intersection ID	
end Intersection ID	
external traffic information system flag	whether or not the Road Section is associated with information from ITS-RSU/VICS / RDS / TMS
toll road flag	whether or not the Road Section is a toll road

7.2.2.2.4 Road element

7.2.2.2.4.1 Definition of road element

Road Element (alias Link) is connected to two Intersection Connection Points that are in each Intersection in the Road Section.

The start and end of Road Element are an Intersection Connection Point at Intersection. Therefore Road Element connects to Intersection logically.

Road Element is associated with Road Section. Road Element associates with Road Element Shape, Lane, Traffic Signal and Road Marking in Road Network Object package. Also Road Element associates with Street Address, Caution Point, District Name, Location Image, Road Signage and Bridge and Tunnel in Road Element Guidance package.

Road Element does not contain any shape information of the road. Road linear shape information defined by polyline is set into Road Element Shape, and road surface shape information defined by polygon is set into Road Marking as option.

The same Road Element in the different level which is composed of the same Intersection Connecting Point must set the same link ID.

7.2.2.2.4.2 Data elements of road element

Road Element is specified by Link ID (i.e. Road Element ID).

Table 3 lists data elements of Road Element.

Table 3 — Data elements of road element

Data Element / Attribute	Note
Road Section ID	
Link connection order	stores the order of links
Link ID	
start Intersection ID	
one-way information	
investigation information	
Lane information existence flag	whether or not the Road Element is associated with lane information

AVA Documents
Document Sharing Hub

© ISO 2016 – All rights reserved

Full document details: BS ISO 14296:2016

Table 3 *(continued)*

Data Element / Attribute	Note
Bridge and Tunnel existence flag	whether or not the Road Element is a Bridge and Tunnel feature
start Intersection Connecting Point ID	
end Intersection Connecting Point ID	
upper level existence flag	whether or not this Road Element exists in the upper level
upper level Link ID	
link type code	
road functional code	
slope information	ascent/ descent/ flat
sidewalk type	
street name existence flag	whether or not the Road Element is associated with the street address
Street Address existence flag	
road name existence flag	
road width(normal direction)	the mean value
road width(opposite direction)	
number of Road Signage	
stop sign existence flag (start / end side)	
speed limits	this is a list of the vehicle type and speed limit value pair
number of Traffic Signals except for Intersections	Traffic Signals for pedestrian crossing / crosswalk in Road Element
pass-through flag	
on-the-street parking lot flag	

7.2.2.2.5 Intersection Connection Point

7.2.2.2.5.1 Definition of Intersection Connection Point

The Intersection Connection Point defines the location point where the Road Element connects with the Intersection Link or other Road Element at Intersection.

The Intersection Connection Points shall be located at the Intersection. Intersection Connection Points are the start point and the end point of Road Element including Intersection Links. Intersection Connection Point is associated with Road Element and Intersection.

When all Road Elements of other Road Section in the Intersection are omitted in the upper level, the Intersection and the Intersection Connecting Point are not set in the upper level.

For example Figure 6 shows crossing single-line roads. The location of Intersection Connection Point (abbreviated term: ICP) may be defined in the centre of the Intersection. There is an ICP in an Intersection. Figure 7 shows crossing double-line roads, the location of each ICP may be defined at entrance point of the Intersection and/or connection point of other Road Element. Four ICPs are set in an Intersection. Figure 8 shows the case of roundabout, the location of each ICP may be defined at entrance point. Four ICPs are set in an Intersection. In the case of Figure 7 and Figure 8, each ICP IDs in an Intersection are different. Also when Road Elements and/or Intersection Connecting Points are aggregated in the upper level, because a location of ICP is changed, it gives different ID to an ICP of upper level. In this case, Figure 6 may indicate an aggregated intersection in upper level and Figures 7 and 8 may indicate an Intersection in lower level.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14296:2016