



BSI Standards Publication

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

National foreword

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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**

*Systèmes de transport intelligents — Spécification de données
dynamiques et de bases de données cartographiques pour les
applications de système de conduite connectées et automatisées —*

*Partie 1: Architecture et modèle logique de données pour
l'harmonisation des données cartographiques statiques*





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Foreword

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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).

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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 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 for being 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.

Implementation of this document 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/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 <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 bounded by three or more Edges or four or more NET coordinate Tuple

[SOURCE: ISO 20524-2:2020, 3.1.]

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 side line 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: This is a general term for the roadway, carriageways, intersections and lanes, and does not contain the sidewalks and paths for pedestrians.

3.10

side line

type of boundary line constituting a belt feature other than a terminal line

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

3.11

terminal line

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
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) Resolution and accuracy of the MHAD
- [Annex D](#) (informative) Comparison of the road network models of MHAD and existing map models

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 test suite in [Annex A](#).

UML expressions for diagrams in this document shall conform to ISO/IEC 19501.

Throughout this document, the data types and stereotypes as defined in [Table B.1](#) apply.

6 Architecture

Automated 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 an ADS.

In ITS vehicle stations that correspond 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 to which the navigation system and/or C-ITS refer.

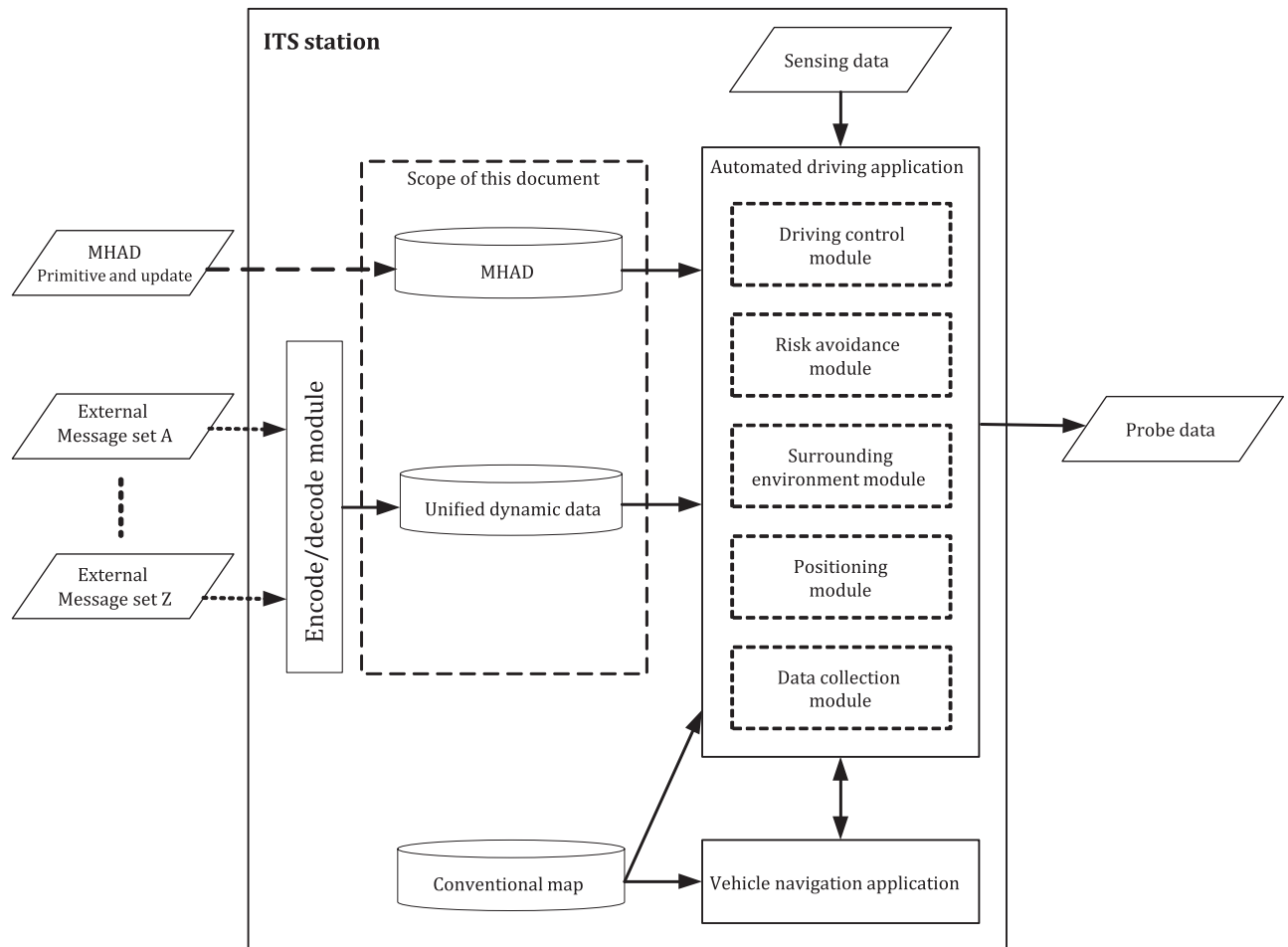


Figure 1 — Conceptual system architecture

7 Logical data model of map data

7.1 Overall data model of map data

The overall map data model for ITS is adopted from the model defined in ISO 14296 which consists of the following packages:

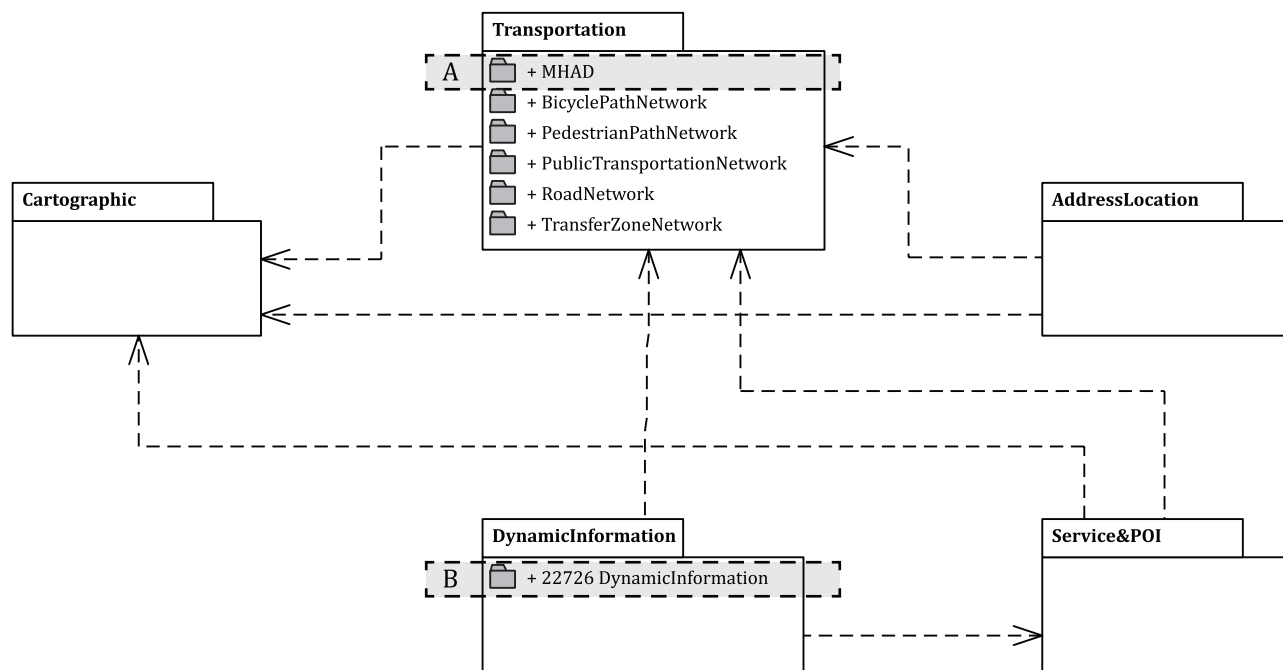
- AddressLocation: location information based on various types of information both on the Earth and in the map data;
- Cartographic: terrain map information for expressing a visual map;
- Service&POI: information of the services and POI that exist in a fixed location;
- Transportation: information concerning fixed features for transportation; and
- DynamicInformation: external information in association with transportation data for providing real-time conditions and/or status.

To support ADS, both the Transportation and DynamicInformation packages are expanded.

The DynamicInformation package is specified in ISO/TS 22726-2:—.¹⁾

The overall map data model is shown in [Figure 2](#).

1) Under preparation. Stage at the time of publication ISO/AWI TS 22726-2:2023.

**Key**

A ISO/TS 22726-1 (this document)

B ISO/TS 22726-2

Figure 2 — Overall map data model**7.2 Transportation package**

Following the addition of the MHAD package to the Transportation package, the updated package consists of the following:

- MHAD: data for road belt network, lane belt network, and road structures and equipment for connected and automated driving systems;
- TransferZoneNetwork: information concerning place and connected network for transferring with the transport network;
- RoadNetwork: static road data using linear network modelling;
- PublicTransportationNetwork: static network data for the public transportation system;
- BicyclePathNetwork: static path network data for bicycle movement; and
- PedestrianPathNetwork: static path network data for pedestrian movement.

The overview of the Transportation package is shown in [Figure 3](#).

The TransferZoneNetwork package and the RoadNetwork package are defined in ISO 14296. The RoadNetwork package contains features represented by links and nodes, in multiple levels corresponding to the concept of different map scales. The features in the MHAD package can be related to road features such as RoadElement, Intersection, IntersectionLink, IntersectionConnectionPoint and Lane in the RoadNetwork package and are described in [Clause D.2](#).

This document only defines the specifications of features in the MHAD package.

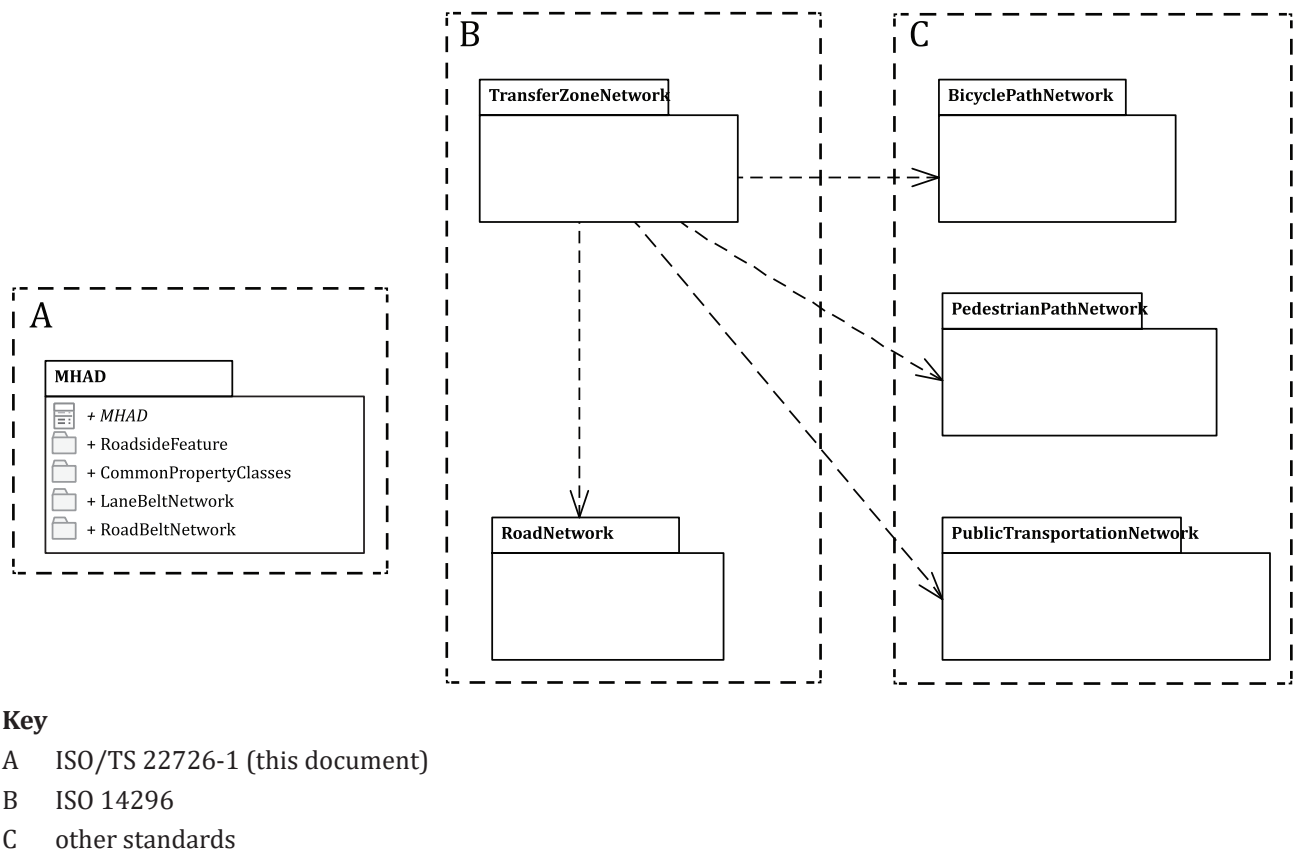


Figure 3 — Transportation package

7.3 MHAD package

7.3.1 General

7.3.1.1 Configuration of MHAD package

A connected and/or automated driving system requires the road belt network data, the lane belt network data and the road structures and equipment data related to road features. The MHAD represents the data model for a static map of the road and consists of the following packages:

- RoadBeltNetwork package — defines belt features and relevant features which compose road-level networks;
- LaneBeltNetwork package — defines belt features and relevant features which compose lane-level networks;
- RoadStructureAndEquipment package — defines road structures and road equipment which are related to road-level and/or lane-level networks;
- CommonPropertyClasses package — defines the data classes commonly used in multiple sub-packages belonging to the MHAD package.

[Figure 4](#) shows the package configuration of the MHAD package.

The MHAD package contains an MHAD class which is defined as the root class for the entire package.

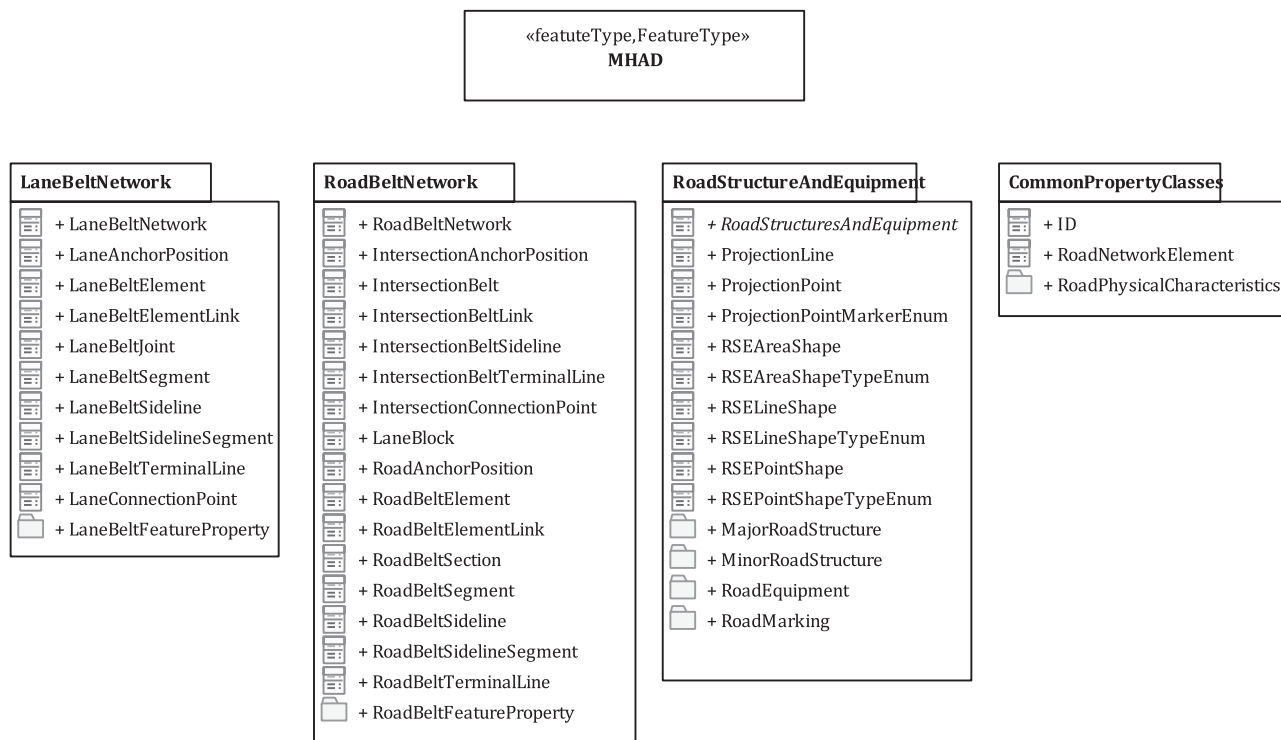


Figure 4 — MHAD package diagram

Figure 5 shows the classes and relationships for expressing the hierarchical model of the MHAD package.

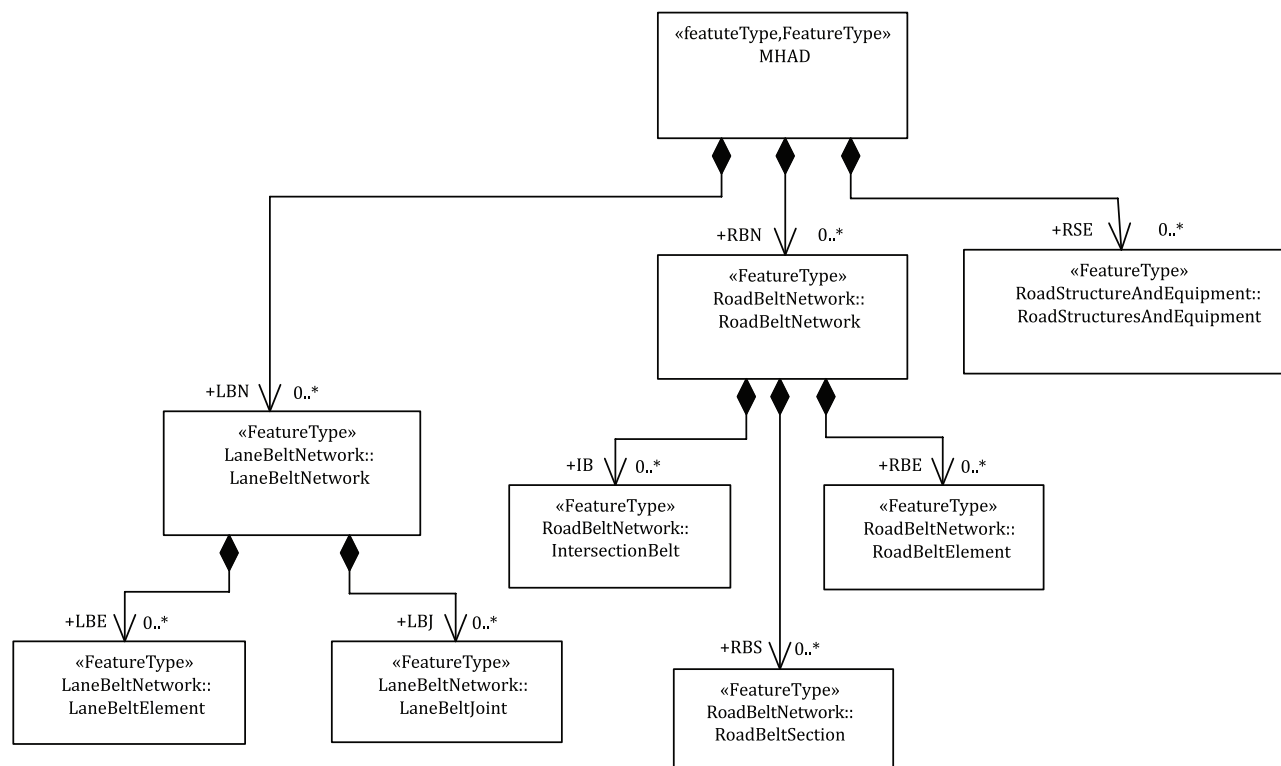


Figure 5 — Class diagram of MHAD package

7.3.1.2 Belt concept for roadway, intersection and lane

Roadways and intersections are expressed by lines and points in conventional road network data models. However, emerging ITS applications (e.g. lane keeping for C-ITS and automated driving systems) require highly defined information that enables the vehicle to identify where it is driving in a lane, and in which lane it is allowed to drive in order to overtake other vehicles.

To provide such information, road features, such as the roadway, intersections and lanes need to be expressed by specific area features which have characteristics implying directions and/or trajectories of moving vehicles. An instance of this specific area feature is transformed into a directed line that corresponds to a possible directed trajectory of regular vehicle movement when it is degenerated by means of a mathematical morphology transformation.

A conventional data model enables a vehicle to identify in which road and/or lane it is driving. However, an area feature in the conventional data model merely expresses a space for free motion and does not imply any specific directions. Thus, the area feature in the conventional data model does not meet the requirements of emerging ITS applications.

The "belt concept" and belt features specified in ISO 20524-2 meet the recommendation that roads, intersections and lanes should be represented by a specific area feature with the directions defined as their characteristics. As illustrated in [Figure 6](#), a belt feature is a specific area feature which is bounded by a combination of side lines and terminal lines.

In the case of a road [[Figure 6 a](#)], a belt has at least one directional characteristic, the "direction". Additionally, the belt can have other characteristics which include the widths of the belt that are calculated as the distance between a pair of side lines for that belt. The value width should be associated with a measure on the degenerated line representing the belt feature.

The terminal lines define the characteristics of the belt direction. In the case of an intersection [[Figure 6 b](#)], a belt has at least two directional characteristics. Widths of a belt are calculated as the distance between a pair of side lines which determine both sides of the belt except in an intersection.

In the belt data model, terminal lines are conceptually represented and assumed to function as "directional control valves" at both ends of a flow. Side lines are also conceptually represented and can refer to real road-related objects (e.g. lane markings, flow-markings, kerbs, guardrails, etc.).

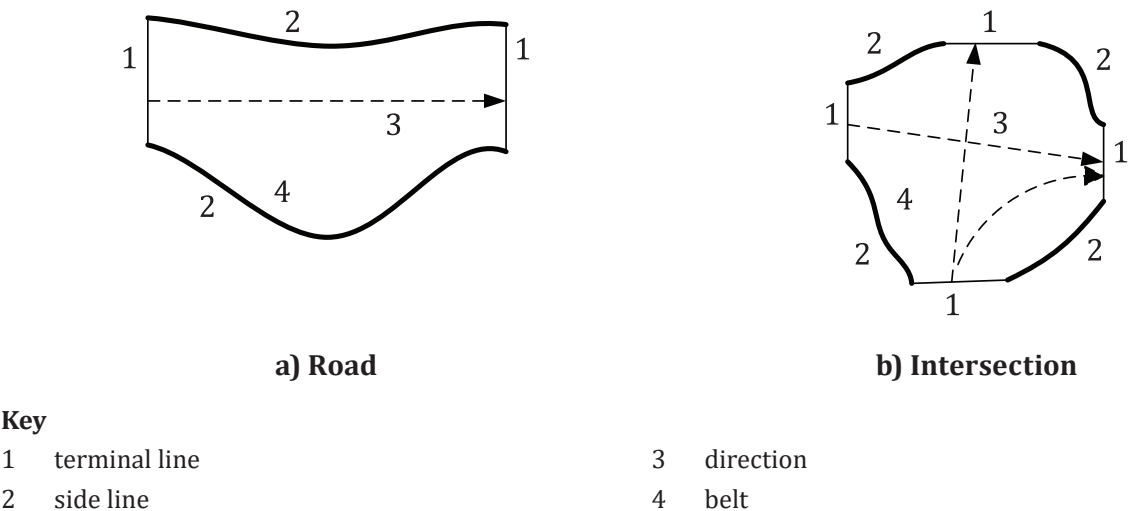


Figure 6 — Example of belt structure

In the MHAD package, road features are instantiated as features in a RoadBeltNetwork package and a LaneBeltNetwork package.

7.3.1.3 Relationship between road feature and road structures and equipment feature

In the real world, there are various features located at or along roads such as road markings, traffic signals, kerbs, manholes, fences, walls, guardrails and poles. These features are referred to as road structures or road equipment and are instantiated as features in the RoadStructureAndEquipment package in MHAD.

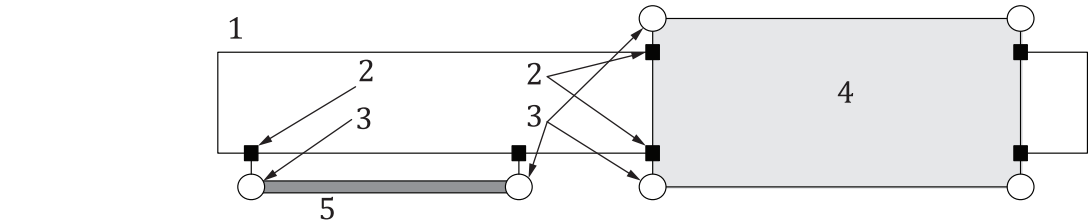
As road structures and road equipment are located at or along a road, they can have relationships with road features such as those defined by the RoadBeltNetwork package and the LaneBeltNetwork package. When road structures and road equipment are interrelated, it is necessary to define the specific location on the road feature that relates to the corresponding part of the road structures and road equipment.

EXAMPLE The outline of a kerb represents the boundary of the kerb itself and at the same time represents a part of a side line of the road feature where that kerb is located.

In the MHAD data model, road features have anchor positions that are used to associate road structures or pieces of road equipment to the road and indicate the position where the road structures and/or road equipment is anchored to the road feature.

A projection point is a point positioned on the geometry of the road structures and road equipment and associated to the anchor position. A projection line is an outline of the road structures or road equipment, partly specified by a pair of projection points. Both the projection point and project line of road structures or road equipment are designed to include traffic restrictions due to the physical properties of the road structures and road equipment, and they can be used as reference positions for positioning functions. Anchor positions are defined as RoadAnchorPosition, IntersectionAnchorPosition and LaneAnchorPosition in either a RoadBeltNetwork or LaneBeltNetwork package.

Figure 7 shows examples of the relationship of anchor positions and projection points between a RoadBeltElement and a bridge and a guardrail.



- Key**
- 1 RoadBeltElement
 - 2 anchor position
 - 3 projection position
 - 4 bridge
 - 5 guardrail

Figure 7 — Example of relationship between a road belt element and a bridge and a guardrail

7.3.1.4 MHAD class

The MHAD class is the root class of the MHAD package and has three composition relationships.

Table 1 defines the details of the MHAD class.

Table 1 — MHAD class

Class<<featureType>>: MHAD				
Definition	Dataset representing the static road network map which consists of the datasets of the road belt network, the lane belt network, and the road structures and equipment.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RoadBeltNetwork	Specifies road belt network data.			
	RoadBeltNetwork	[0..*]		Composition relationship
role: LaneBeltNetwork	Specifies lane belt network data.			
	LaneBeltNetwork	[0..*]		Composition relationship
role: RoadStructureAnd-Equipment	Specifies road structures and equipment data.			
	RoadStructureAndE- quipment	[0..*]		Composition relationship

7.3.2 RoadBeltNetwork package

7.3.2.1 General

7.3.2.1.1 Configuration of RoadBeltNetwork package

The RoadBeltNetwork package defines the road features of carriageways and intersections represented by the belt concept.

The RoadBeltNetwork package consists of:

- RoadBeltNetwork,
- RoadBeltElement,
- RoadBeltElementLink,
- RoadBeltSideLine,
- RoadBeltSideLineSegment,
- RoadBeltTerminalLine,
- RoadBeltSegment,
- RoadAnchorPosition,
- IntersectionBelt,
- IntersectionBeltLink,
- IntersectionSideLine,
- IntersectionTerminalLine,
- IntersectionConnectionPoint,
- IntersectionAnchorPosition,
- RoadBeltSection, and
- LaneBlock.

Figure 8 shows the classes and relationships of road features in the RoadBeltNetwork package (see <https://standards.iso.org/iso/ts/22726/-1/ed-1/en> for an enlarged version of this figure).

Additionally, the `RoadBeltNetwork` package contains a `RoadBeltFeatureProperty` package which defines the properties used in the road feature belonging to the `RoadBeltNetwork`.

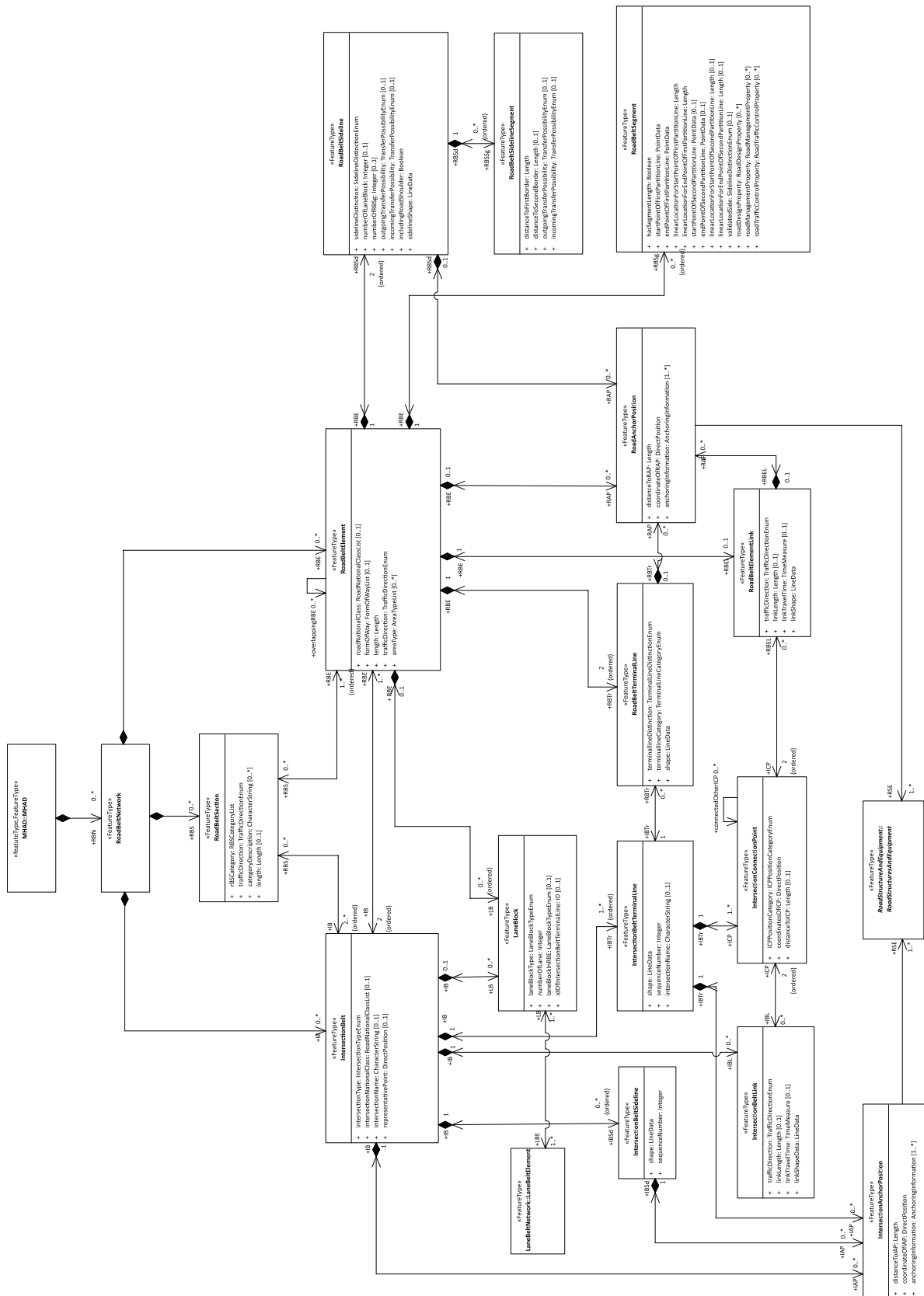


Figure 8 — RoadBeltNetwork package

7.3.2.1.2 Modelling policy of RoadBeltNetwork

A RoadBeltNetwork is a class and is specified as the root class of the RoadBeltNetwork package, supporting a hierarchical model. A RoadBeltNetwork class has composition relationships to:

- IntersectionBelt,
- RoadBeltElement, and
- RoadBeltSection.

The network of RoadBeltNetwork consists of the IntersectionBelts, RoadBeltElements and relationships between IntersectionBelt and RoadBeltElement. It is also a networking concept in ISO 20524-2. Additionally, RoadBeltElement has composition relationships to:

- RoadBeltSideLine,
- RoadBeltTerminalLine,
- RoadBeltSegment,
- RoadBeltElementLink,
- LaneBlock, and
- RoadAnchorPosition.

An IntersectionBelt has composition relationships to:

- IntersectionBeltSideLine,
- IntersectionBeltTerminalLine,
- IntersectionBeltLink,
- LaneBlock, and
- IntersectionAnchorPosition.

The composition relationships listed above accommodate the requirements of ADS applications which are enabled to easily and quickly access properties of the road feature side lines and links as the vehicle moves.

[Figure 9](#) shows the configurations of RoadBeltElement and IntersectionBelt.

A RoadBeltElement consists of two RoadBeltSideLines, two RoadBeltTerminalLines and a RoadBeltElementLink. The physical domain of a RoadBeltElement is defined by property data of RoadBeltSideLines and RoadBeltTerminalLines.

A RoadBeltElementLink is a feature that corresponds to the geometry data of a RoadBeltElement when it is degenerated by means of mathematical morphology transformations.

The first RoadBeltSideLine represents the right-side line with reference to the forward direction of RoadBeltElement while the second RoadBeltSideLine represents the left side line. The direction of the RoadBeltElement is determined by a pair of RoadBeltTerminalLines. The first RoadBeltTerminalLine represents the origin of the forward direction of RoadBeltElement and the second RoadBeltTerminalLine represents the destination.

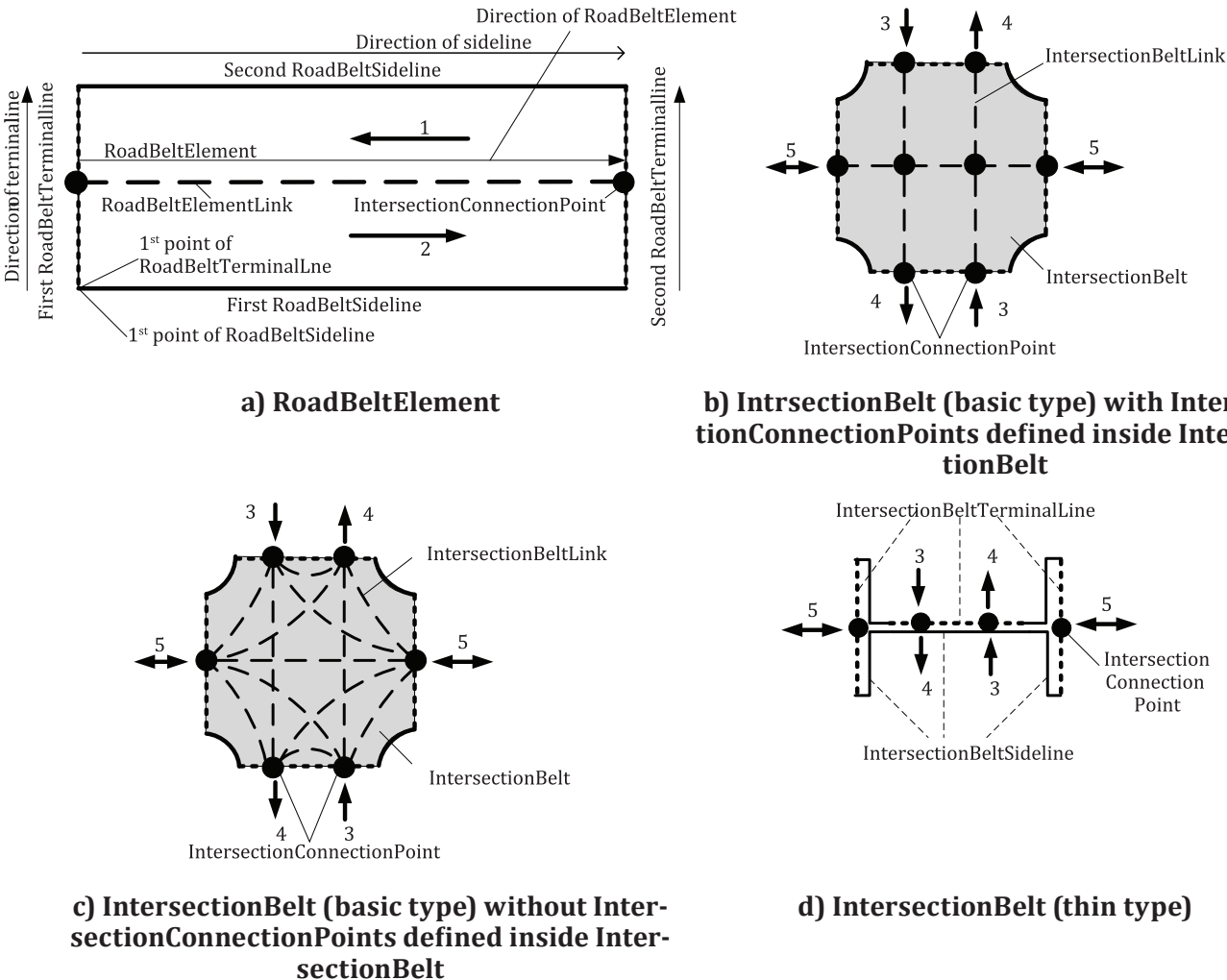
The starting point of a RoadBeltElementLink is referred to as "the first point" and is located on the first RoadBeltTerminalLine and the ending point of each RoadBeltElementLine is referred to as "the second point" and is located on the second RoadBeltTerminalLine.

RoadBeltElements and IntersectionBelts are connected by their respective TerminalLines. A RoadBeltElement should be connected to a pair of IntersectionBelts, but a RoadBeltElement connected to the same IntersectionBelt, i.e., a circular RoadBeltElement, shall not be permitted.

An IntersectionBelt is distinguished as either a basic belt type or thin belt type according to the area of an intersection. A configuration example of a thin belt type IntersectionBelt is shown in [Figure 9 d](#)).

An IntersectionBelt that is connected to the first RoadBeltTerminalLine of a RoadBeltElement is referred to as the first IntersectionBelt for that RoadBeltElement. When another IntersectionBelt connected the RoadBeltElement is referred to as the second IntersectionBelt for that RoadBeltElement. The forward direction of a RoadBeltElement is specified as the direction from the first RoadBeltTerminalLine moving toward the second RoadBeltTerminalLine.

The traffic direction in the real world can be defined with reference to the direction of the RoadBeltElement. The traffic flow direction identified by key element “1”, illustrated in [Figure 9 a](#)), is opposite to the belt direction. The traffic flow direction identified by key element “2” is the same direction as the belt direction.



Key

1 - 5 traffic flow direction

Figure 9 — RoadBeltElement and IntersectionBelt with relevant features defined in RoadBeltNetwork package

IntersectionBeltSideLines and IntersectionBeltTerminalLines are connected in a counterclockwise chain and can be specified by the sequence number.

An IntersectionBeltLink is a feature that represents a linear representation generated by the degeneration of the Intersection Belt and is equivalent to a link in a linear network model. The degeneration is carried out by means of a mathematical morphology transformation.

An IntersectionConnectionPoint can be defined inside an IntersectionBelt. [Figure 9 b\)](#) and [Figure 9 c\)](#) illustrate examples of two distinct definitions of an IntersectionBeltLink depending on whether or not the IntersectionConnectionPoints are defined inside the IntersectionBelt.

The traffic direction inside an IntersectionBelt can be defined by the traffic flow direction (entering/exiting) with reference to the RoadBeltElementLink located on the IntersectionConnectionPoint on the terminal lines of the IntersectionBelt. The traffic flow direction identified by key element "3", illustrated in [Figure 9 b\)](#) and [Figure 9 c\)](#), is entering into the IntersectionBelt. The traffic flow direction identified by key element "4" is exiting from the IntersectionBelt. The traffic flow direction identified by key "5" is bidirectional, meaning both entering and exiting flows to the IntersectionBelt.

In implementations of ADS applications, the traffic flow direction of the carriageway should be specified with reference to the direction of the RoadBeltElement. [Figure 10](#) describes an example of the configuration of the traffic flow direction and the direction of RoadBeltElement.

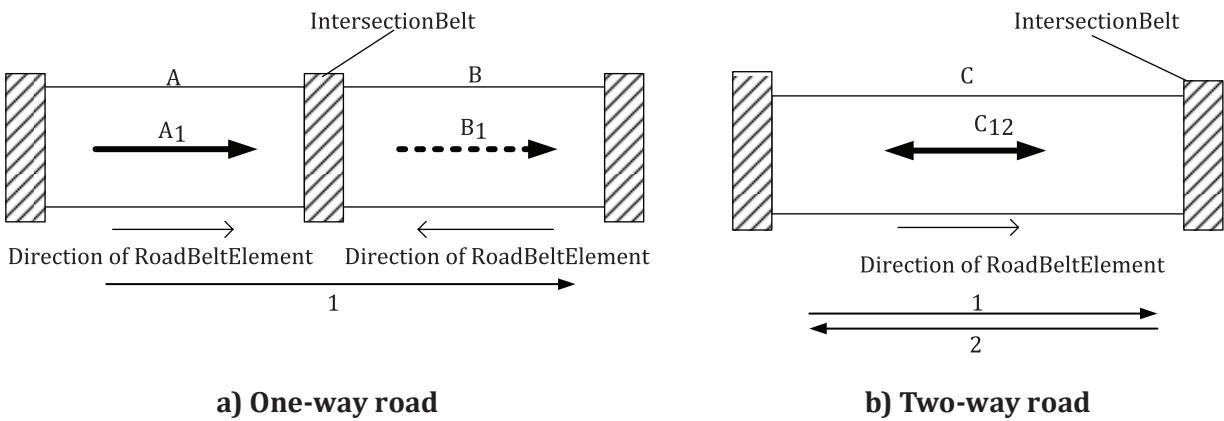
In a one-way road, illustrated in [Figure 10 a\)](#), when the traffic flow direction is in the same direction as the RoadBeltElement, it should be referred to as "forward direction".

Conversely traffic flow direction opposite to the direction of the RoadBeltElement should be referred to as "reverse direction".

NOTE 1 Specifically, the traffic flow direction identified by key element "1" illustrated in [Figure 10 a\)](#) is defined as the forward direction, key element "A₁" with reference to the direction of key element "A". The traffic direction key element "1" is specified as the reverse direction, key element "B₁" with reference to the direction of key element "B".

In a two-way road illustrated in [Figure 10 b\)](#), the traffic flow direction should be referred to as bidirectional. Each traffic flow direction is identifiable with reference to the direction of the RoadBeltElement.

NOTE 2 Specifically, the traffic flow direction in a two-way carriageway, identified by both key element "1" and key element "2", [Figure 10 b\)](#), is specified as bidirectional (key element "C₁₂"). The traffic flow direction identified by key element "1" or key element "2" is identifiable as the forward or reverse direction with reference to the direction of key "C".



Key

- 1 and 2 traffic flow direction in the real world
- A, B and C RoadBeltElement
- A₁, B₁, and C₁₂ description of the traffic flow direction specified with reference to the direction of RoadBeltElement

Figure 10 — Relation between the traffic flow direction and the direction of RoadBeltElement

When existing on the same vertical level, an IntersectionBelt should not overlap any IntersectionBelts and any RoadBeltElements. A RoadBeltElement can overlap with adjacent RoadBeltElements for branching or merging.

7.3.2.2 RoadBeltNetwork

RoadBeltNetwork class is a class that may be instantiated and represents a branch class having only three composition relationships and used for expressing the hierarchical model.

Table 2 defines the details of the RoadBeltNetwork class.

Table 2 — RoadBeltNetwork class

Class<<featureType>>: RoadBeltNetwork				
Definition	Dataset representing the road network which consists of the datasets of the road belt element, intersection belt and road belt section.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RoadBeltElement	Specifies data in a road belt element belonging to the road belt network.			
	RoadBeltElement	[0..*]		Composition relationship
role: IntersectionBelt	Specifies data in an intersection belt belonging to the road belt network.			
	IntersectionBelt	[0..*]		Composition relationship
role: RoadBeltSection	Specifies data in a road belt section belonging to the road belt network.			
	RoadBeltSection	[0..*]		Composition relationship

7.3.2.3 IntersectionAnchorPosition

IntersectionAnchorPosition is defined on IntersectionBeltSideLines and IntersectionBeltTerminalLines depending on the position of a projection point of RoadStructureAndEquipment.

[Table 3](#) defines the details of IntersectionAnchorPosition class.

Table 3 — IntersectionAnchorPosition class

Class<<featureType>>: IntersectionAnchorPosition				
Definition	Feature that represents the anchor position used to relate road structures and road equipment with the intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RSE	Specifies a road structure or a piece of road equipment data linked with the intersection anchor position.			
	RoadStructureAndEquipment	[1..*]		Association relationship
distanceToIAP	Distance from the first point of the intersection belt terminal line or the intersection belt side line to the intersection anchor position.			
	Length	[1]		
coordinateOfIAP	Coordinates of the intersection anchor position.			
	DirectPosition	[1]		
anchoringInformation	Anchoring information of the road structure or a piece of road equipment.			
	AnchoringInformation	[1..*]		

7.3.2.4 IntersectionBelt

IntersectionBelt does not contain geometry data because IntersectionBeltSideLines and IntersectionBeltTerminalLines contain geometry data.

[Table 4](#) defines the details of the IntersectionBelt class.

Table 4 — IntersectionBelt class

Class<<featureType>>: IntersectionBelt				
Definition	Road belt feature which represents the intersecting part of a road where one road is split into two or more roads or where roads merge into one road, or a roundabout.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RBE	Specifies a road belt element connected to the intersection belt.			
	RoadBeltElement	[1..*]		Association relationship
role: RBS	Specifies a road belt section including the intersection belt.			
	RoadBeltSection	[0..*]		Association relationship
role: LB	Specifies a lane block located in the intersection belt.			
	LaneBlock	[0..*]		Composition relationship {ordered} ^a
role: IBL	Specifies an intersection belt link existing in the intersection belt.			
	IntersectionBeltLink	[0..*]		Composition relationship
role: IBSD	Specifies an intersection belt side line in the intersection belt.			
	IntersectionBeltSideLine	[0..*]		Composition relationship
^a The order of LaneBlock is counted by the sequence of IntersectionBeltTerminalLine for grouping by connected ingress (or egress) RoadBeltElement.				
^b The intersection name can be different for each approach road at the intersection. In such cases, the intersection names are given in each IntersectionBeltTerminalLine.				

Table 4 (continued)

role: IBTr	Specifies an intersection belt terminal line in the intersection belt.			
	IntersectionBeltTerminalLine	[0..*]		Composition relationship
role: IAP	Specifies an intersection anchor position located in the intersection belt.			
	IntersectionAnchorPosition	[0..*]		Composition relationship
intersectionType	Type of an intersection.			
	IntersectionTypeEnum	[1]		
intersectionNationalClass	Class of an intersection based on a national classification.			
	RoadNationalClassList	[0..1]		
intersectionName	Name of the intersection.			
	CharacterString	[0..1]		^b
representativePoint	Central point of the intersection belt.			
	DirectPosition	[0..1]		
^a The order of LaneBlock is counted by the sequence of IntersectionBeltTerminalLine for grouping by connected ingress (or egress) RoadBeltElement.				
^b The intersection name can be different for each approach road at the intersection. In such cases, the intersection names are given in each IntersectionBeltTerminalLine.				

7.3.2.5 IntersectionBeltLink

Both ends of an IntersectionBeltLink should be located at the IntersectionConnectionPoint defined on the IntersectionBeltTerminalLine.

If the IntersectionConnectionPoints are defined within the IntersectionBelt, the IntersectionBeltLink can be located at these inner IntersectionConnectionPoints.

In the case that an IntersectionBeltLink can be equivalent to an IntersectionLink defined in RoadNetwork package, an IntersectionBeltLink can be associated with an IntersectionLink.

An IntersectionConnectionPoint located at the starting point of the IntersectionBeltLink is designated as the first IntersectionConnectionPoint, and an IntersectionConnectionPoint located at the end point of the IntersectionBeltLink is designated as the second IntersectionConnectionPoint.

[Table 5](#) defines the details of the IntersectionBeltLink class.

Table 5 — IntersectionBeltLink class

Class<<featureType>>: IntersectionBeltLink				
Definition	Feature that represents a linear representation generated by the degeneracy of the intersection belt equivalent to a link in a linear network model in an intersection.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: ICP	Specifies the first and the second intersection connection points connected to the intersection belt link.			
	IntersectionConnectionPoint	[2]		Association relationship {ordered}
trafficDirection	Direction of traffic flow of the intersection belt link.			
	TrafficDirectionEnum	[1]		
linkLength	Length of the intersection belt link shape.			
	Length	[0..1]		

Table 5 (continued)

linkTravelTime	Estimated travel time for passing through the intersection belt link.			
	TimeMeasure	[0..*]		
linkShapeData	Geometry data of the intersection belt link.			
	LineData	[1]		

7.3.2.6 IntersectionBeltSideLine

IntersectionBeltSideLines and IntersectionBeltTerminalLines are chained in a counterclockwise direction. Therefore, the start point of an IntersectionBeltSideLine is located at the starting side of the chain.

[Table 6](#) defines the details of the IntersectionBeltSideLine class.

Table 6 — IntersectionBeltSideLine class

Class<<featureType>>: IntersectionBeltSideLine				
Definition	Feature which represents the side line of an intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IAP	Specifies an intersection anchor position on the intersection belt side line.			
	IntersectionAnchorPosition	[0..*]		Composition relationship
shapeData	Geometry data of the intersection belt side line.			
	LineData	[1]		
sequenceNumber	Sequence number of an intersection belt side line that is comprised in the intersection belt outline. This number is defined in a counterclockwise direction.			
	Integer	[1]		

7.3.2.7 IntersectionBeltTerminalLine

IntersectionBeltSideLines and IntersectionBeltTerminalLines are chained in a counterclockwise direction. Therefore, the start point of an IntersectionBeltTerminalLine is located at the starting side of the chain.

[Table 7](#) defines the details of the RoadBeltTerminalLine class.

Table 7 — IntersectionBeltTerminalLine class

Class<<featureType>>: IntersectionBeltTerminalLine				
Definition	Feature which represents the terminal line of an intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: ICP	Specifies an intersection connection point that exists on the intersection belt terminal line.			
	IntersectionConnectionPoint	[1..*]		Composition relationship
role: RBTr	Specifies a road belt terminal line connected to the intersection belt terminal line.			
	RoadBeltTerminalLine	[1..*]		Association relationship
role: IAP	Specifies an intersection anchor position on the intersection belt terminal line.			
	IntersectionAnchorPosition	[0..*]		Composition relationship

Table 7 (continued)

shapeData	Geometry data of the intersection belt terminal line.			
	LineData	[1]		
sequenceNumber	Sequence number of an intersection belt terminal line that is part of the intersection belt outline. This number is defined in a counterclockwise direction.			
	Integer	[1]		
intersectionName	Usual name of an intersection based on the road entering the intersection.			
	CharacterString	[0..1]		

7.3.2.8 IntersectionConnectionPoint

An IntersectionConnectionPoint is defined on an IntersectionBeltTerminalLine of an IntersectionBelt for representing the connection between a RoadBeltElementLink and an IntersectionBeltLink. An IntersectionConnectionPoint can be defined within an IntersectionBelt for representing the connection between IntersectionBeltLinks. The location of an IntersectionConnectionPoint can be specified by degenerating the IntersectionBeltTerminalLine into a point geometry.

[Table 8](#) defines the details of the IntersectionConnectionPoint class.

Table 8 — IntersectionConnectionPoint class

Class<<featureType>>: IntersectionConnectionPoint				
Definition	Feature that represents a connection point joining a road belt element link to an intersection belt link or adjoining road belt element links, or that connects an intersection belt link to adjoining road belt element links or other intersection belt links.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IBL	Specifies an intersection belt link connected to the intersection connection point.			
	IntersectionBeltLink	[0..*]		Association relationship
role: RBEL	Specifies a road belt element link connected to the intersection connection point.			
	RoadBeltElementLink	[0..*]		Association relationship
role: connectedOther-ICP	Specifies another intersection connection point in the same intersection, connected to the intersection connection point.			
	IntersectionConnectionPoint	[0..*]		Association relationship
iCPPositionCategory	Position category where the intersection connection point exists.			
	ICPPositionCategoryEnum	[1]		
coordinatesOfICP	Coordinates of the intersection connection point.			
	DirectPosition	[1]		
distanceToICP	Distance from the first point of the intersection belt terminal line where this intersection connection point is located.			
	Length	[0..1]		If ICPPositionCategory is an 'internalPoint', it is omitted.

IntersectionConnectionPoint ensures the linear network connectivity between a RoadBeltElementLink and an IntersectionBeltLink, between RoadBeltElementLinks, and between IntersectionBeltLinks by specifying the association. An IntersectionConnectionPoint should have at least one association with either RoadBeltElementLink or IntersectionBeltLink.

When creating networks without IntersectionBeltLink inside IntersectionBelt, the linear network connectivity inside the IntersectionBelt can be provided by means of the association ("Role name: connectedOtherICP").

The association “*Role name*: connectedOtherICP” implies a direct network connection from the current IntersectionConnectionPoint to other IntersectionConnectionPoints specified by the association role.

7.3.2.9 LaneBlock

An Individual LaneBlock is associated to either a RoadBeltElement or an IntersectionBelt.

A LaneBlock in relation to RoadBeltElement provides information on a group of LaneBeltElement defined in an entire RoadBeltElement. RoadBeltElement or a segment thereof. A RoadBeltElement can be semantically partitioned at the following locations:

- where a RoadBeltElement connects to an IntersectionBelt (i.e. terminal line of RoadBeltElement);
- where the number of lanes begins to increase (or decrease);
- where the number of lanes finishes to increase (or decrease);
- where an important characteristic change of a RoadBeltElement regarding lanes begins and ends;

EXAMPLE A junction (branching/merging), the beginning (or end) of the narrowing (or widening) of the road width, the border of freely accessible area in front of (or behind) the tollgate, etc.

- where an important characteristic change of RoadBeltElement regarding lanes is completed.

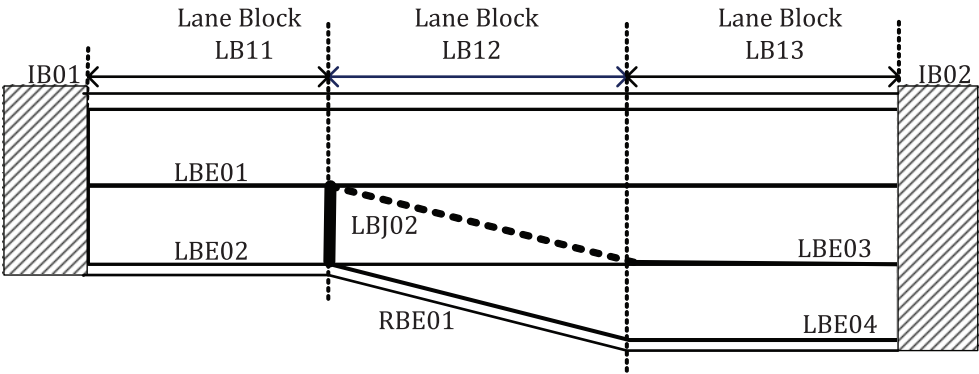
LaneBeltElement should be defined inside each segment when RoadBeltElement is divided into multiple segments by above conditions. This means inevitably that RoadBeltElement can be segmented by the following characteristics based on the composition of a LaneBeltElement:

- invariable in the number of lanes;
- homogeneous; and/or
- altered by either branching, merging, narrowing or widening.

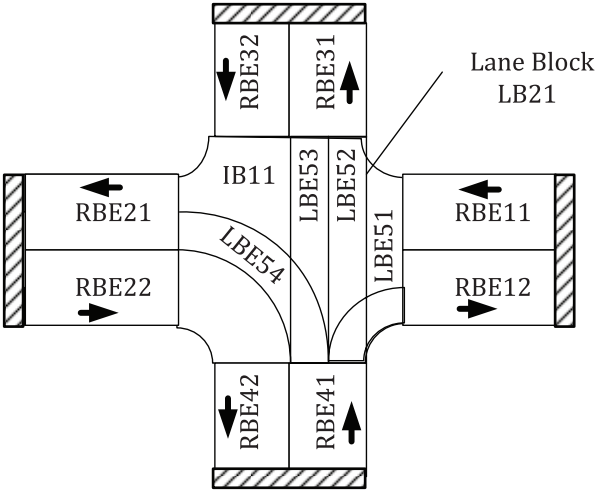
Three examples of a LaneBlock (LS11, LS12 and LS13) in relation to RoadBeltElement (RBE01) are shown in [Figure 11 a](#)). LS11 is defined between the terminal line of RBE01 and the location where the number of lanes begins to increase (or the point where the decreasing number of lanes is completed). LS12 is defined in the segment where the characteristic of the RoadBeltElement changes, e.g. the road width changes, and the lane is widening (or narrowing). LS13 is defined between the terminal line of RBE01 and the location where the road width change is complete (or begins). A LaneBlock in the RoadBeltElement can be defined for each traffic flow direction.

A LaneBlock in relation to an IntersectionBelt provides information on a group of LaneBeltElements defined inside the IntersectionBelt. All LaneBeltElements inside an IntersectionBelt can be defined as one LaneBlock, or a group of LaneBeltElements for each ingress (or egress) RoadBeltElement connected to the IntersectionBeltTerminalLine can be defined as one LaneBlock.

An example of LaneBlock (LB21) in relation to an IntersectionBelt (IB11) is shown in [Figure 11 b](#)). LB21 is defined as a group of four LaneBeltElements (i.e. LBE51, LBE52, LBE53 and LBE54) related to IntersectionBeltTerminalLine and connected at ingress RoadBeltElement (RBE41).



a) LaneBlock for RoadBeltElement



b) LaneBlock for IntersectionBelt

Figure 11 — Example of LaneBlock for RoadBeltElement and IntersectionBelt

Table 9 defines the details of the LaneBlock class.

Table 9 — LaneBlock class

Class<<featureType>>: LaneBlock				
Definition	Feature which represents a group of lane belt elements in a defined area, either a whole road belt element, a segment of road belt element, or whole intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: LBE	Specifies a lane belt element belonging to the lane block.			
	LaneBeltElement	[1..*]		Association relationship
laneBlockType	Type of lane block where either a road or intersection exists.			
	LaneBlockTypeEnum	[1]		
numberOfLane	The number of lanes in the lane block.			
	Integer	[1]		

Table 9 (continued)

laneBlockInRBE	Properties of a lane block that exists in a road belt element.			
	LaneBlockInRBE	[0..1]		it occurs when LaneBlock-Type is "in RBE"
idOfIntersectionBelt-TerminalLine	Identifier of an intersection belt terminal line, specified as either ingress or egress, and used for grouping lane belt elements in an intersection belt.			
	ID	[0..1]		it occurs when Lane-Block Type is "ingress" or "egress"

7.3.2.10 RoadAnchorPosition

The RoadAnchorPosition for a RoadBeltElement is located on a RoadBeltSideLine, a RoadBeltTerminalLine, and/or a RoadBeltElementLink depending on the location of either the Projection point or a Projection line of a RoadStructureAndEquipment class.

[Table 10](#) defines the details of RoadAnchorPosition class.

Table 10 — RoadAnchorPosition class

Class<<featureType>>: RoadAnchorPosition				
Definition	Feature which represents the anchor position to associate road structure or a piece of road equipment with the road belt element.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RSE	Specifies a road structure or a piece of road equipment associated to the road anchor position.			
	RoadStructureAndEquipment	[1..*]		Association relationship
distanceToRAP	Distance from the first point of the road belt side line, road belt terminal line or road belt element link to the anchor position.			
	Length	[1]		
coordinateOfRAP	Coordinates of the road anchor position.			
	PointData	[1]		
anchoringInformation	Anchoring information of the road structure and/or a piece of road equipment.			
	AnchoringInformation	[1..*]		

7.3.2.11 RoadBeltElement

A RoadBeltElement has no geometry data for the defining area, because a RoadBeltSideLine and a RoadBeltTerminalLine have geometry data.

[Table 11](#) defines the details of the RoadBeltElement class.

Table 11 — RoadBeltElement class

Class<<featureType>>: RoadBeltElement	
Definition	Road belt feature which represents a part of a road, excluding intersections, which is used for the movement of vehicles.
^a	The order of LaneBlock is counted from first terminal line of RBE.
^b	The order of RoadBeltSegment is counted from first terminal line of RBE.
^c	The order of RoadAnchorPosition is counted by order of BeltLineCategory of line and the distance from first point of its line.

Table 11 (continued)

Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IB	Specifies the first or the second intersection belt connected to the road belt element.			
	IntersectionBelt	[2]		Association relationship {ordered}
role: RBS	Specifies a road belt section that includes the road belt element.			
	RoadBeltSection	[0..*]		Association relationship
role: LB	Specifies a lane block located in a road belt element.			
	LaneBlock	[1..*]		Composition relationship {ordered} ^a
role: overlappingRBE	Specifies an adjacent road belt element overlapping the road belt element.			
	RoadBeltElement	[0..*]		Association relationship
role: RBEL	Specifies a road belt element link of the road belt element.			
	RoadBeltElementLink	[0..1]		Composition relationship
role: RBSd	Specifies a road belt side line belonging to the road belt element.			
	RoadBeltSideLine	[2]		Composition relationship {ordered}
role: RBTr	Specifies a road belt terminal lines of the road belt element.			
	RoadBeltTerminalLine	[2]		Composition relationship {ordered}
role: RBSg	Specifies a road belt segment located in the road belt element.			
	RoadBeltSegment	[0..*]		Composition relationship {ordered} ^b
role: RAP	Specifies a road anchor position located on the road belt element.			
	RoadAnchorPosition	[0..*]		Composition relationship {ordered} ^c
roadNationalClass	Class of a road based on a national classification.			
	RoadNationalClassList	[0..1]		
formOfWay	Code representing the form of way.			
	FormOfWayList	[0..1]		
length	Length between the first and second terminal line along a central line.			
	Length	[1]		
trafficDirection	Direction of traffic flow of the road belt element.			
	TrafficDirectionEnum	[1]		
areaType	Category of a specific area where a road exists.			
	AreaTypeList	[0..*]		
^a The order of LaneBlock is counted from first terminal line of RBE.				
^b The order of RoadBeltSegment is counted from first terminal line of RBE.				
^c The order of RoadAnchorPosition is counted by order of BeltLineCategory of line and the distance from first point of its line.				

7.3.2.12 RoadBeltElementLink

RoadBeltElementLink should be located between IntersectionConnectionPoints located on the IntersectionTerminalLine of the adjoining IntersectionBelt.

The direction of a RoadBeltElementLink should be in the same direction as the RoadBeltElement.

Line geometry of a RoadBeltElementLink can be specified by degenerating a RoadBeltElement into a line geometry.

An IntersectionConnectionPoint is located at the starting point of a RoadBeltElementLink and is designated as the first IntersectionConnectionPoint. The IntersectionConnectionPoint located at the end point of a RoadBeltElementLink is designated as the second IntersectionConnectionPoint.

[Table 12](#) defines the details of the RoadBeltElementLink class.

Table 12 — RoadBeltElementLink class

Class<<featureType>>: RoadBeltElementLink				
Definition	Feature which represents a linear representation generated by the degeneracy of road belt element, which is equivalent to the link of a linear network model.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: ICP	Specifies the first or the second intersection connection points connected to the road belt element link.			
	IntersectionConnection-Point	[2]		Association relationship {ordered}
role: RAP	Specifies a road anchor position on the road belt element link.			
	RoadAnchorPosition	[0..*]		Composition relationship
trafficDirection	Direction of traffic flow of the road belt element link.			
	TrafficDirectionEnum	[1]		
linkLength	Length of the line shape of the road belt element link.			
	Length	[0..1]		
linkTravelTime	Estimated travel time for passing through the link.			
	TimeMeasure	[0..1]		
linkShapeData	Geometry data of the road belt element link.			
	LineData	[1]		

7.3.2.13 RoadBeltSection

A RoadBeltSection is a dataset which represents one route such as an avenue/street or a detour and where RoadBeltElements and IntersectionBelts are located in series.

Both ends of a RoadBeltSection should be IntersectionBelts. All RoadBeltElements that compose a RoadBeltSection shall support appropriate traffic direction of the RoadBeltSection to enable continuity of flow of traffic from start to end of the RoadBeltSection. If traffic direction does not support the flow throughout the RoadBeltElement, the RoadBeltElement shall not be adopted in the configuration of the RoadBeltSection. If the traffic direction of the RoadBeltSection is bidirectional, all constituent RoadBeltElements should be bidirectional.

[Table 13](#) defines the details of the RoadBeltSection class.

Table 13 — RoadBeltSection class

Class<<featureType>>: RoadBeltSection	
^a	The order of RoadBeltElement is counted from the starting RBE because RoadBeltSection consists of a sequence of IBs and RBEs.
^b	The order of IntersectionBelt is counted from the starting IB because RoadBeltSection consists of a sequence of IBs and RBEs.
^c	If the traffic direction of all RoadBeltElements is bidirectional, the traffic direction of RoadBeltSection is defined as bidirectional.

Table 13 (continued)

Definition	Feature that represents a route or a diversion to which road belt elements and intersection belts belong.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IB	Specifies an intersection belt comprising the road belt section.			
	IntersectionBelt	[2..*]		Association relationship {ordered} ^a
role: RBE	Specifies a road belt element comprising the road belt section.			
	RoadBeltElement	[1..*]		Association relationship {ordered} ^b
rBSCategory	Category of the road belt section.			
	RBSCategoryList	[1]		
trafficDirection	Passable direction of the road belt section. Direction is forward when travel from the first intersection to the last intersection can be passed, reverse when travel from the last intersection to the first intersection can be passed, and bidirectional when both can be passed.			
	TrafficDirectionEnum	[1]		^c
categoryDescription	Description of category of the road belt section.			
	CharacterString	[0..*]		
length	Length from the start intersection to the last intersection.			
	Length	[1]		
^a The order of RoadBeltElement is counted from the starting RBE because RoadBeltSection consists of a sequence of IBs and RBEs.				
^b The order of IntersectionBelt is counted from the starting IB because RoadBeltSection consists of a sequence of IBs and RBEs.				
^c If the traffic direction of all RoadBeltElements is bidirectional, the traffic direction of RoadBeltSection is defined as bidirectional.				

7.3.2.14 RoadBeltSegment

A RoadBeltSegment is either a segment area of RoadBeltElement surrounded by two partition lines (transversals) and two side lines or a partition line located in a RoadBeltElement. The side line is a part of RoadBeltSideLine so line shape data is omitted to avoid duplication with RoadBeltSideLine. The partition line is a straight line jointing two points on RoadBeltSideLine on both sides so line shape data is end points only. Therefore, the shape of RoadBeltSegment is represented by either two or four points. The first partition line is located at the starting side of the orientation of the RoadBeltElement and the start point of the partition line is located at the first RoadBeltSideLine.

[Table 14](#) defines the details of RoadBeltSegment class.

Table 14 — RoadBeltSegment class

Class<<featureType>>: RoadBeltSegment				
Definition	Feature that represents a part (possibly of zero-length) of a road belt element that is distinct from other parts with respect to a particular characteristic.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
hasSegmentLength	Indicates if the road belt segment has a length (true) or is zero-length (false).			
	Boolean	[1]	{true: section, false: transversal}	
^a If segment type is a line, End partition line does not exist.				
^b If the segment characteristic applies with full width of RoadBeltElement. The item 'validatedSide' is null.				

Table 14 (continued)

startPointOfFirstPartitionLine	Coordinates of the start point of the first partition line that is located on the first road belt side line.		
	PointData	[1]	
endPointOfFirstPartitionLine	Coordinates of the end point of the first partition line that is located on the second road belt side line.		
	PointData	[1]	
linearLocationForStartPointOfFirstPartitionLine	Distance along first road belt side line from the first point of that road belt side line to the start point of the first partition line.		
	Length	[1]	
linearLocationForEndPointOfFirstPartitionLine	Distance along second road belt side line from the first point of that road belt side line to the end point of the first partition line.		
	Length	[1]	
startPointOfSecondPartitionLine	Coordinates of the start point of the second partition line that is located on the first road belt side line.		
	PointData	[0..1]	a
endPointOfSecondPartitionLine	Coordinates of the end point of the second partition line that is located on the second road belt side line.		
	PointData	[0..1]	a
linearLocationForStartPointOfSecondPartitionLine	Distance along first road belt side line from the first point of that road belt side line to the start point of the second partition line.		
	Length	[0..1]	
linearLocationForEndPointOfSecondPartitionLine	Distance along second road belt side line from the first point of that road belt side line to the end point of the second partition line.		
	Length	[0..1]	
validatedSide	Distinction of the side line when applying the segment properties to a portion of road belt element on either the first or second road belt side line side.		
	SideLineDistinctionEnum	[0..1]	b
roadDesignProperty	Properties of the road design.		
	RoadDesignProperty	[0..*]	
roadManagementProperty	Properties of the road management used in an ADS.		
	RoadManagementProperty	[0..*]	
roadTrafficControlProperty	Properties of the lane traffic control used in an ADS.		
	RoadDesignProperty	[0..*]	
a If segment type is a line, End partition line does not exist.			
b If the segment characteristic applies with full width of RoadBeltElement. The item 'validatedSide' is null.			

7.3.2.15 RoadBeltSideLine

[Table 15](#) defines the details of RoadBeltSideLine class.

Table 15 — RoadBeltSideLine class

Class<<featureType>>: RoadBeltSideLine	
Definition	Feature that represents properties of a side line of a road belt element. The first point of the road belt side line is located at the first road belt terminal line.
a The order of RoadBeltSideLineSegment is counted by the distance from the first point of RoadBeltSideLine to start point of RBSSg.	

Table 15 (continued)

Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RAP	Specifies a road anchor position located on the road belt side line.			
	RoadAnchorPosition	[0..*]		Composition relationship
role: RBSSg	Specifies a road belt side line segment belonging to the road belt side line.			
	RoadBeltSideLineSegment	[0..*]		Composition relationship {ordered} ^a
sideLineDistinction	Distinction that identifies the first or the second side line.			
	SideLineDistinctionEnum	[1]		
numberOfLaneBlock	The number of lane block on the road belt side line.			
	Integer	[0..1]		
numberOfRBSg	The number of the road belt segment located on the road belt side line.			
	Integer	[0..1]		
outgoingTransferPossibility	Transfer possibility of outgoing direction across a side line of a road belt element.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossibility	Transfer possibility of incoming direction across a side line of a road belt element.			
	TransferPossibilityEnum	[0..1]		
includingRoadShoulder	Indicates if a road shoulder is included (true) or not (false) in a road belt element.			
	Boolean	[1]	{true: include / false: not include}	
sideLineShapeData	Geometry data of the road belt side line.			
	LineData	[1]		
^a The order of RoadBeltSideLineSegment is counted by the distance from the first point of RoadBeltSideLine to start point of RBSSg.				

7.3.2.16 RoadBeltSideLineSegment

Table 16 defines the details of the RoadBeltSideLineSegment class.

Table 16 — RoadBeltSideLineSegment class

Class<<featureType>>: RoadBeltSideLineSegment				
Definition	Feature which represents the properties of a specific portion of road belt side line.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
distanceToFirstBorder	Distance from the first point of the road belt side line to the start point of the road belt side line segment.			
	Length	[1]		
distanceToSecondBorder	Distance from the first point of the road belt side line to the end point of the road belt side line segment.			
	Length	[0..1]		
outgoingTransferPossibility	Transfer possibility of outgoing direction of the side line segment.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossibility	Transfer possibility of incoming direction of the side line segment.			
	TransferPossibilityEnum	[0..1]		

7.3.2.17 RoadBeltTerminalLine

[Table 17](#) defines the details of the RoadBeltTerminalLine class.

Table 17 — RoadBeltTerminalLine class

Class<<featureType>>: RoadBeltTerminalLine				
Definition	Feature which represents the terminal line of road belt element. A start point of the road belt terminal line is located at the first road belt side line.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IBTr	Specifies an intersection belt terminal line connected to a road belt terminal line.			
	IntersectionBeltTerminalLine	[1..*]		Composition relationship
role: RAP	Specifies a road anchor position on the road belt terminal line.			
	RoadAnchorPosition	[0..*]		Composition relationship
terminalLineDistinction	Distinction that identifies the first or the second terminal line.			
	TerminalLineDistinction Enum	[1]		
terminalLineCategory	Category of the terminal line.			
	TerminalLineCategoryEnum	[1]		
shapeData	Geometry data of the road belt terminal line.			
	LineData	[1]		

7.3.2.18 RoadBeltFeatureProperty package

7.3.2.18.1 General

RoadBeltFeatureProperty package contains the properties for road belt feature classes belonging to a RoadBeltNetwork. [Figure 12](#) shows a class diagram of RoadBeltFeatureProperty.

The RoadBeltFeatureProperty package contains a RoadBeltSegmentProperty package defining the properties of the RoadBeltSegment feature.

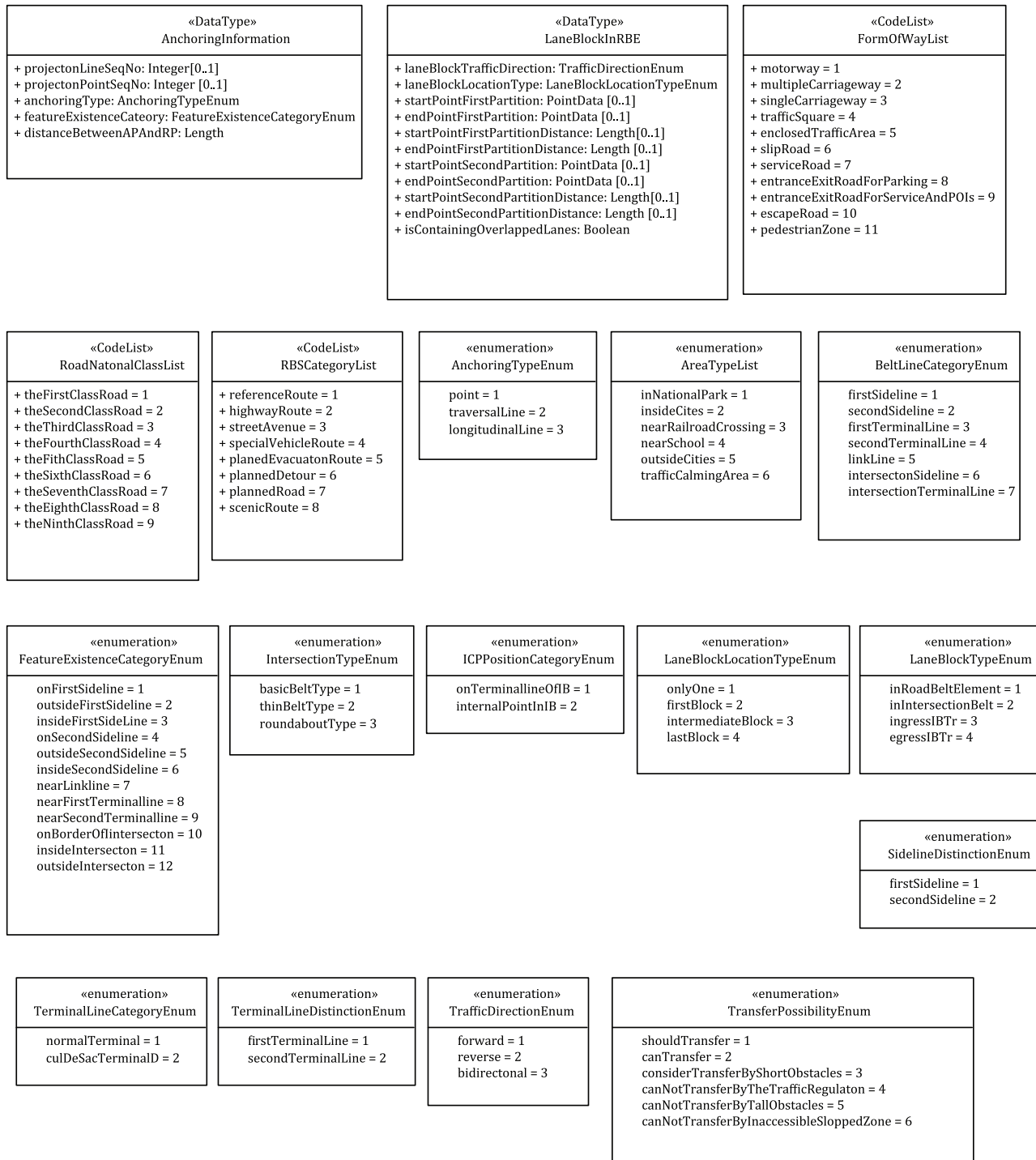


Figure 12 — Class diagram of RoadBeltFeatureProperty

7.3.2.18.2 AnchoringInformation

[Table 18](#) defines the details of the AnchoringInformation class.

Table 18 — AnchoringInformation class

Class<<dataType>>: AnchoringInformation				
Definition	Information about a projection point and/or projection line of a road structure or a piece of road equipment that is attached to an anchor position.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
projectionLineSeqNo	Sequence number of a projection line of the road structure or a piece of road equipment.			
	Integer	[0..1]		
projectionPointSeqNo	Sequence number of a projection point of the road structure or a piece of road equipment.			
	Integer	[0..1]		
anchoringType	Type of the anchoring characteristics of the road feature.			
	AnchoringTypeEnum	[1]		
featureExistenceCategory	Category defining where a projection point of the road structure, or a piece of road equipment exists.			
	FeatureExistenceCategoryEnum	[1]		
distanceBetweenAPAndRP	Distance between the road anchor position and a projection point of the road structure or a piece of road equipment.			
	Length	[1]		

7.3.2.18.3 AnchoringTypeEnum

[Table 19](#) defines the details of the AnchoringTypeEnum class.

Table 19 — AnchoringTypeEnum class

Class<<enumeration>>: AnchoringTypeEnum		
Definition	Available list of enumerations for types of the arrangement characteristic on the road feature.	
Code	Value	Definition
1	point	Road structure or a piece of road equipment that is anchored to an anchor position by the projection point in a projection line or representative point.
2	traversalLine	Road structure or a piece of road equipment that is anchored to an anchor position by a projection point in a projection line along the traversal direction which is perpendicular to the primary axis of a road feature.
3	longitudinalLine	Road structure or a piece of road equipment that is anchored to an anchor position by a projection point in a projection line along the longitudinal direction which defines the axis aligned with the primary axis of a road feature.

7.3.2.18.4 AreaTypeList

[Table 20](#) defines the details of the AreaTypeList class.

Table 20 — AreaTypeList class

Class<<enumeration>>: AreaTypeList		
Definition		Available list of enumerations for types of special area where the road exists.
Code	Value	Definition
1	inNationalPark	Within the boundary of a recognized national park.
2	insideCities	Within the notional or actual boundary of a city.
3	nearRailroadCrossing	Near a railway level crossing.
4	nearSchool	Near a school.
5	outsideCities	Outside the notional or actual boundary of a city.
6	trafficCalmingArea	In a zone which is subject to traffic calming measures.

7.3.2.18.5 BeltLineCategoryEnum

[Table 21](#) defines the details of BeltLineCategoryEnum class.

Table 21 — BeltLineCategoryEnum class

Class<<enumeration>>: BeltLineCategoryEnum		
Definition		Available list of enumerations of a line element that constitutes a belt feature.
Code	Value	Definition
1	firstSideLine	The first side line of a road or lane belt.
2	secondSideLine	The second side line of a road or lane belt.
3	firstTerminalLine	The first terminal line of a road or lane belt.
4	secondTerminalLine	The second terminal line of a road or lane belt.
5	linkLine	Line that can be associated to a belt feature for representation in a road link (uni-dimensional) graph.
6	intersectionSideLine	Side line of an intersection belt.
7	intersectionTerminalLine	Terminal line of an intersection belt.

7.3.2.18.6 FeatureExistenceCategoryEnum

[Table 22](#) defines the details of the FeatureExistenceCategoryEnum class.

Table 22 — FeatureExistenceCategoryEnum class

Class<<enumeration>>: FeatureExistenceCategoryEnum		
Definition		Available list of enumerations for a position where a projection point of a road structure, or a piece of road equipment exists.
Code	Value	Definition
1	onFirstSideLine	The road structure or the road equipment is located on the first side line.
2	outsideFirstSideLine	The road structure or the road equipment is located outside the first side line.
3	insideFirstSideLine	The road structure or the road equipment is located inside the first side line.
4	onSecondSideLine	The road structure or the road equipment is located on the second Side line.
5	outsideSecondSideLine	The road structure or the road equipment is located outside the second side line.
6	insideSecondSideLine	The road structure or the road equipment is located inside the second side line.

Table 22 (continued)

7	nearLinkline	The road structure or the road equipment is located near the link line.
8	nearFirstTerminalLine	The road structure or the road equipment is located near the first terminal line.
9	nearSecondTerminal line	The road structure or the road equipment is located near the second terminal line.
10	onBorderOfIntersec tion	The road structure or the road equipment is located on the border of the intersection
11	outsideIntersection	The road structure or the road equipment is located outside the intersection.
12	insideIntersection	The road structure or the road equipment is located inside the intersection

7.3.2.18.7 FormOfWayList

[Table 23](#) defines the details of the FormOfWayList class.

Table 23 — FormOfWayList class

Class<<CodeList>>: FormOfWayList		
Definition		Available list of enumerations for the form of way. [Source: ISO 20524-1:2020].
Code	Value	Definition
1	motorway	Road specially designed and built for motor traffic which does not cross, at the same level, with any road or motorway, railway or tramway track, or footpath.
2	multipleCarriageway	Road that is composed of several carriageways separated by physical traffic separators.
3	singleCarriageway	Road that is composed of only one carriageway. Note: A single carriageway road segment could have multiple lanes and could allow travel in opposite directions.
4	trafficSquare	Public square or equivalent area that is passable by vehicles.
5	enclosedTrafficArea	An enclosed area that is passable by vehicles.
6	slipRoad	Lane(s) providing access to and exit from a through road.
7	serviceRoad	Subsidiary road parallel to a more important road with adjacent buildings or properties facing thereon and connected with that road only at a limited number of points.
8	entranceExitRoadFor-Parking	Road to enter and/or to exit from the parking facility.
9	entranceExitRoadForSer-viceAndPOIs	Road to enter and/or to exit from the service and POI facility.
10	escapeRoad	Ramp designed to stop out-of-control vehicles, usually lorries, by using gravel arrester beds, reverse gradients, or a combination of both.
11	pedestrianZone	Street or group of streets designed primarily to meet the needs of pedestrians and where the speed and dominance of motor vehicles are reduced.

7.3.2.18.8 ICPPositionCategoryEnum

[Table 24](#) defines the details of the ICPPositionCategoryEnum class.

Table 24 — ICPPositionCategoryEnum class

Class<<enumeration>>: ICPPositionCategoryEnum		
Definition		Available list of enumerations for a position category where an intersection connection position exists.
Code	Value	Definition
1	onTerminalLineOfIB	An intersection connection point exists on the intersection belt terminal line.
2	internalPointInIB	An intersection connection point exists inside of the intersection belt.

7.3.2.18.9 IntersectionTypeEnum

[Table 25](#) defines the details of the IntersectionTypeEnum class.

Table 25 — IntersectionTypeEnum class

Class<<enumeration>>: IntersectionTypeEnum		
Definition		Available list of enumerations for type of the intersection.
Code	Value	Definition
1	basicBeltType	An intersection is represented by an area.
2	thinBeltType	An intersection is represented by a line and has no inner area representing this intersection.
3	roundaboutType	A special basic belt type, that represents one basic belt type and only contains circular internal links.

7.3.2.18.10 LaneBlockInRBE

A LaneBlock in RoadBeltElement is a segment area surrounded by two partition lines and two side line and is represented by four points; an intersection of the first side line and the first partition line, an intersection of the second side line and the first partition line, an intersection of the first side line and the second partition line, and an intersection of the second side line and the second partition line.

The first partition line is located at the starting side of the orientation of the RoadBeltElement and the starting point of the partition line is located at the first RoadBeltSideLine and is referred to as "the first point".

[Table 26](#) defines the details of the LaneBlockInRBE class.

Table 26 — LaneBlockInRBE class

Class<<dataType>>: LaneBlockInRBE				
Definition	A lane block in the road belt element represents the characteristics regarding lanes and is an area surrounded by two partition lines and two side lines of the road belt element.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
laneBlockTrafficDirection	Traffic direction of the lane block.			
	TrafficDirectionEnum	[1]		
laneBlockLocationType	Distinction of the position of the lane block set in the road belt element.			
	LaneBlockLocation-TypeEnum	[1]		
startPointFirstPartition	The first point of the first partition line that is located at the first side line.			
	PointData	[0..1]		

Table 26 (continued)

endPointFirstPartition	The second point of the first partition line that is located at the second side line.		
	PointData	[0..1]	
startPointFirstPartitionDistance	Distance from the first point of the first road belt side line to the first point of the first partition line.		
	Length	[0..1]	{it occurs if location type = 3 or 4}
endPointFirstPartitionDistance	Distance from the first point of the second road belt side line to the second point of the first partition line.		
	Length	[0..1]	{it occurs if location type = 3 or 4}
startPointSecondPartition	The first point of the second partition line that is located at the first side line.		
	PointData	[0..1]	
endPointSecondPartition	The second point of the second partition line that is located at the second side line.		
	PointData	[0..1]	
startPointSecondPartitionDistance	Distance from the first point of the first road belt side line to the first point of the second partition line.		
	Length	[0..1]	{it occurs if location type = 2 or 3}
endPointSecondPartitionDistance	Distance from the first point of the second road belt side line to the second point of the second partition line.		
	Length	[0..1]	{it occurs if location type = 2 or 3}
isContainingOverlappedLanes	Determines if the lane block contains overlapped lanes (true) or not (false).		
	Boolean	[1]	{true: contain / false: not contain}

7.3.2.18.11 LaneBlockLocationTypeEnum

[Table 27](#) defines the details of the LaneBlockLocationTypeEnum class.

Table 27 — LaneBlockLocationTypeEnum class

Class<<enumeration>>: LaneBlockLocationTypeEnum		
Definition		Available list of enumerations for the location order in the carriageway.
Code	Value	Definition
1	onlyOne	There is one lane block in the road belt element.
2	firstBlock	The lane block is located in the first block of the road belt element.
3	intermediateBlock	The lane block is located in the intermediate block of the road belt element.
4	lastBlock	The lane block is located in the last block of the road belt element.

7.3.2.18.12 LaneBlockTypeEnum

[Table 28](#) defines the details of the LaneBlockTypeEnum class.

Table 28 — LaneBlockTypeEnum class

Class<<enumeration>>: LaneBlockTypeEnum		
Definition		Available list of enumerations where a lane block exists.
Code	Value	Definition
1	inRoadBeltElement	The lane block exists in a road belt element.
2	inIntersectionBelt	The lane block exists in the entire intersection belt.
3	ingressIBTr	The lane block exists in the intersection belt and groups lanes corresponding to an ingress intersection belt terminal line.

Table 28 (continued)

4	egressIBTr	The lane block exists in the intersection belt and groups lanes corresponding to an egress intersection belt terminal line.
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7.3.2.18.13 RBSCategoryList

[Table 29](#) defines the details of the RBSCategoryList class.

Table 29 — RBSCategoryList class

Class<<CodeList>>: RBSCategoryList		
Definition		Available list of enumerations for the road belt section.
Code	Value	Definition
1	referenceRoute	The road section is specified as a reference route.
2	highwayRoute	The road section is specified as a highway route.
3	streetOrAvenue	The road section is specified as a street or avenue.
4	specialVehicleRoute	The road section is specified as a special vehicle route.
5	plannedEvacuationRoute	The road section is specified as a planned evacuation route.
6	plannedDetour	The road section is specified as a planned detour.
7	plannedRoad	The road section is specified as a planned road, not yet operational.
8	scenicRoute	The road section is specified as a scenic route.

7.3.2.18.14 RoadNationalClassList

[Table 30](#) defines the details of the RoadNationalClassList class.

Table 30 — RoadNationalClassList class

Class<<CodeList>>: RoadNationalClassList		
Definition		Available list of enumerations representing the national classification of the road. NOTE The properties of this list are from examples defined in ISO 20524-1:2020.
Code	Value	Definition
1	theFirstClassRoad	The highest-class road.
2	theSecondClassRoad	The second higher-class road.
3	theThirdClassRoad	The third higher-class road.
4	theFourthClassRoad	The fourth higher-class road.
5	theFifthClassRoad	The fifth higher-class road.
6	theSixthClassRoad	The sixth higher-class road.
7	theSeventhClassRoad	The seventh higher-class road.
8	theEighthClassRoad	The eighth higher-class road.
9	theNinthClassRoad	The lowest-class road.

7.3.2.18.15 SideLineDistinctionEnum

[Table 31](#) defines the details of the SideLineDistinctionEnum class.

Table 31 — SideLineDistinctionEnum class

Class<<enumeration>>: SideLineDistinctionEnum		
Definition		Available list of enumerations for either the first or second side line.
Code	Value	Definition

Table 31 (continued)

1	firstSideLine	The side line on the right side of the direction from the first terminal line to the second terminal line of a road belt element or lane belt element.
2	secondSideLine	The side line on the left side of the direction from the first terminal line to the second terminal line of a road belt element or lane belt element.

7.3.2.18.16 TerminalLineCategoryEnum

[Table 32](#) defines the details of the TerminalLineCategoryEnum class.

Table 32 — TerminalLineCategoryEnum class

Class<<enumeration>>: TerminalLineCategoryEnum		
Definition		Available list of enumerations for a terminal line for a road belt element and lane belt element.
Code	Value	Definition
1	normalTerminal	Terminal line other than a cul-de-sac terminal line.
2	culDeSacTerminal	Terminal line of a cul-de-sac or a terminal line of a road or lane connected to a cul-de-sac intersection.

7.3.2.18.17 TerminalLineDistinctionEnum

[Table 33](#) defines the details of the TerminalLineDistinctionEnum class.

Table 33 — TerminalLineDistinctionEnum class

Class<<enumeration>>: TerminalLineDistinctionEnum		
Definition		Available list of enumerations for the location of either the first or second terminal line of a road belt element and a lane belt element.
Code	Value	Definition
1	firstTerminalLine	Located at the starting side of the orientation of a road belt element or lane belt element.
2	secondTerminalLine	Located at the ending side of the orientation of a road belt element or lane belt element.

7.3.2.18.18 TrafficDirectionEnum

[Table 34](#) defines the details of the TrafficDirectionEnum class.

Table 34 — TrafficDirectionEnum class

Class<<enumeration>>: TrafficDirectionEnum		
Definition		Available list of enumerations for traffic flow direction as referenced to the belt direction of the road feature.
Code	Value	Definition
1	forward	The traffic flow direction is in the same orientation as the belt direction of the road feature.
2	reverse	The traffic flow direction is in the reverse orientation to the belt direction of the road feature.
3	bidirectional	The traffic flow direction is bidirectional supporting traffic flow in both the forward and reverse directions simultaneously.

7.3.2.18.19 TransferPossibilityEnum

Table 35 defines the details of the TransferPossibilityEnum class.

Table 35 — TransferPossibilityEnum class

Class<<enumeration>>: TransferPossibilityEnum		
Definition		Available list of enumerations for the transfer possibility to an adjacent space.
Code	Value	Definition
1	shouldTransfer	A vehicle should move to an adjacent space.
2	canTransfer	A vehicle can move to an adjacent space.
3	considerTransferByShortObstacles	A vehicle can consider transferring around short obstacles.
4	cannotTransferByTheTrafficRegulation	A vehicle cannot transfer around the traffic regulation.
5	cannotTransferByTallObstacles	A vehicle cannot move to an adjacent space due to tall obstacles.
6	cannotTransferByInaccessibleSlopedZone	A vehicle cannot move to an adjacent space due to an inaccessible sloped zone.

7.3.2.19 RoadBeltSegmentProperty package

7.3.2.19.1 General

The RoadBeltSegmentProperty sub-package contains the property classes for the RoadBeltSegment feature. Figure 13 shows the class diagram of a RoadBeltFeatureProperty.

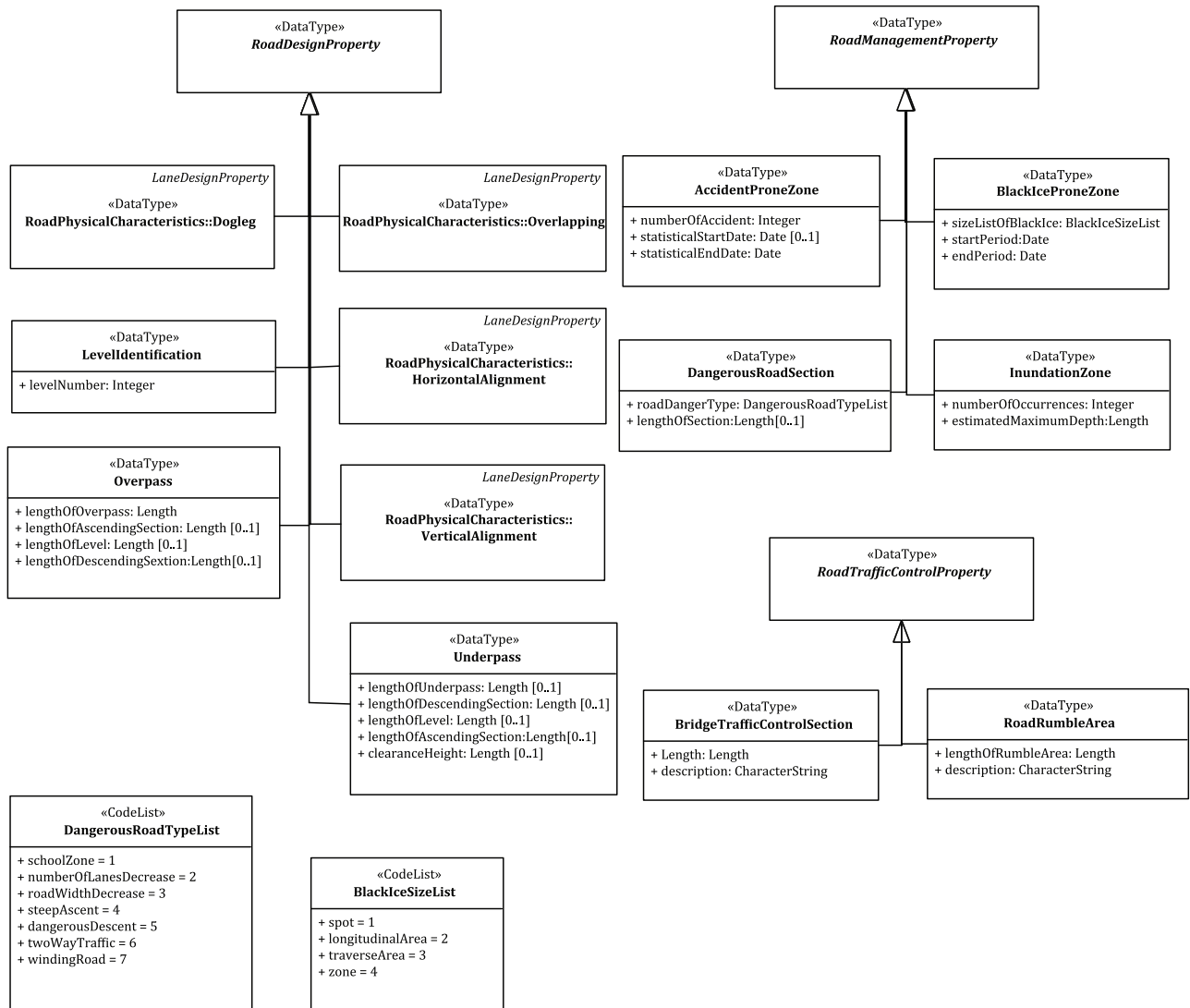


Figure 13 — Class diagram of RoadBeltSegmentProperty

7.3.2.19.2 AccidentProneZone

Table 36 defines the details of the AccidentProneZone class.

Table 36 — AccidentProneZone class

Class<<dataType>>: AccidentProneZone				
Definition	A zone where it has been identified that the likelihood of accidents is raised.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
numberOfAccident	The number of traffic accidents that occurred during the statistical reporting period.			
	Integer	[1]		
startPeriodOfStatistic	Start date of the statistical reporting period.			
	Date	[0..1]		
endPeriodOfStatistic	End date of the statistical reporting period.			
	Date	[0..1]		