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Entwurf

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Vorgesehen als Ersatz für
DIN CEN/TS 16157-2
(DIN SPEC 91270):2011-12

**Intelligente Verkehrssysteme –
DATEX II Datenaustauschspezifikation für Verkehrsmanagement und
Verkehrsinformationen –
Teil 2: Ortsreferenzierung;
Englische Fassung prEN 16157-2:2017**

Intelligent transport systems –
DATEX II data exchange specifications for traffic management and information –
Part 2: Location referencing;
English version prEN 16157-2:2017

Systèmes de transport intelligents –
Spécifications DATEX II d'échanges de données pour la gestion du trafic et l'information
routière –
Partie 2: Localisation;
Version anglaise prEN 16157-2:2017

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Dieser Norm-Entwurf mit Erscheinungsdatum 2017-06-16 wird der Öffentlichkeit zur Prüfung und
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Gesamtumfang 190 Seiten

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DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Nationales Vorwort

Dieses Dokument (prEN 16157-2:2017) wurde vom Technischen Komitee CEN/TC 278 „Intelligente Verkehrssysteme“ ausgearbeitet, dessen Sekretariat von NEN (Niederlande) gehalten wird.

Das zuständige deutsche Normungsgremium ist der Gemeinschaftsarbeitsausschuss NA 052-02-71 GA „Intelligente Verkehrssysteme“ des Normenausschusses Automobiltechnik.

Der Entwurf ist derzeit zur Umfrage vorgelegt.

Dieser Normentwurf definiert eine gemeinsame Menge von Datenaustausch Spezifikationen um die Vision vom interoperablen Austausch von Verkehrs- und Reiseinformationsdaten über Grenzen hinweg zu ermöglichen.

Dieser Normentwurf basiert weiterhin auf einem Weißbuch der europäischen Kommission, welches die Koordination von Verkehrsmanagement und die Entwicklung von übergangslosen paneuropäischen Diensten festlegt.

Dieser Normentwurf umfasst einen großen Anwender- und Wirtschaftsbereich angefangen vom Systemhersteller, über Infrastruktur- und Dienstanbieter bis hin zum Endnutzer von Verkehrs- und Reiseinformationen.

Änderungen

Gegenüber DIN CEN/TS 16157-2 (DIN SPEC 91270):2011-12 wurden folgende Änderungen vorgenommen:

- a) Überführung in eine Europäische Norm;
- b) Einführung einer neuen Ortsreferenzierung nach ISO/TS 21217-22 „OpenLR“;
- c) Einführung eines neuen Ortsreferenzierung-G-Systems;
- d) Einführung von Eigenschaften zum Umgang mit 3D-Koordinaten und Genauigkeitsbewertungen;
- e) Korrektur verschiedener Fehler.

Nationaler Anhang NA (informativ)

Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach EN 16157-1, EN 16157-7 und die folgenden Begriffe.

3.1

Gebiet

(en: aera)

zweidimensionale, geografische Region auf der Erdoberfläche

[QUELLE: ISO 17572-1:2015 [1]]

3.2

vertrauenswürdige Ellipse

(en: confidence ellipse)

horizontale Ortsgenauigkeit in Form einer Ellipse mit einem vordefinierten Vertrauensgrad (z. B. 95 %) mit dem Zentrum, welches dem Referenzpositionspunkt entspricht, für den die Ortsgenauigkeit ermittelt wurde

[QUELLE: ETSI/TS 102 894-2 V1.2.1 (2014-09)]

3.3

Beschreiber

(en: descriptor)

Charakteristik eines geografischen Objekts, welches normalerweise in einem Attribut abgelegt ist

BEISPIEL Straßennamen oder Straßennummern.

3.4

Zielort

(en: destination)

Spezifikation eines Endpunktes einer festgelegten Strecke oder Reiseroute

Anmerkung 1 zum Begriff: Dies kann entweder eine Netzwerk- oder Gebietsposition sein.

3.5

ellipsoidische Höhe

(en: ellipsoidial height)

Abstand von einem Punkt des Ellipsoids, gemessen entlang der Senkrechten vom Ellipsoiden zu einem positiven Punkt, wenn dieser aufwärts oder außerhalb des Ellipsoids ist

[QUELLE: EN ISO 19111:2007]

3.6

Europäisches Terrestrisches Referenzsystem 89

(en: european terrestrial reference system 89)

ETRS89

empfohlenes terrestrisches Referenzsystem für Europa, welches mit dem ITRS des Zeitraumes 1989.0 übereinstimmt

Anmerkung 1 zum Begriff: Im Unterschied zu ITRS ist ETRS auf den festen Teil der europäischen Platte zentriert und nicht der kontinentalen europäischen Drift unterworfen.

3.7

geodätische Koordinate

(en: geodetic coordinate)

eine, aus der Sequenz von zwei (oder drei) Nummern, welche die Position eines Punktes anzeigt, ausgedrückt in *geodätische Breite*, *geodätische Höhe* und (im dreidimensionalen Fall) der *ellipsoidischen- oder schwerkraftbezogenen Höhe*

Anmerkung 1 zum Begriff: In Anlehnung an ISO 19111:2007.

3.8

schwerkraftbezogene Höhe

(en: gravity-related height)

Höhe, abhängig vom Schwerkraftfeld der Erde

[QUELLE: EN ISO 19111:2007]

3.9

Raster

(en: grid)

spezielles Beispiel für einen viereckigen Ort, gegeben durch eine viereckige Grundform, welche ihre untere linke Zelle, multipliziert mit dem Norden (zur Festlegung der Zeilenanzahl) und dem Osten (zur Festlegung der Spaltenanzahl) ist

3.10

ILOC-Bezeichner

(en: ILOC descriptor)

einer der drei *Bezeichner*, welche einer *ILOC*-Referenz zugeordnet sind

3.11

Internationales Terrestrisches Referenzsystem

(en: international terrestrial reference system)

ITRS

Referenzsystem der Erde, welches von präziser und akkurater räumlicher Erdvermessung abgeleitet ist und nicht auf die GPS-Doppler-Messung beschränkt ist, welche periodisch durch den Internationalen Erdumdrehungsdienst (en: International Earth Rotation Service, I.E.R.S.) aufgezeichnet und überarbeitet wird

[QUELLE: ISO 17572-1:2015]

3.12

Reiseroute

(en: itinerary)

Gruppe von einer oder mehreren physikalischen separaten Positionen, welche als geordnete Menge eine Route darstellen

3.13

Breite

geodätische Breite

(en: latitude)

geodetic latitude)

Winkel von der äquatorialen Fläche zur Senkrechten der Erde durch einen gegebenen Punkt, nach Norden hin positiv gewertet

Anmerkung 1 zum Begriff: In Anlehnung an ISO 19111:2007.

3.14**Bezugslinie**

(en: line string)

Kurve bestehend aus geradlinigen Segmenten

[QUELLE: EN ISO 19136:2009]

3.15**linear**

(en: linear)

besitzt einen eindimensionalen Charakter

Anmerkung 1 zum Begriff: In Anlehnung an ISO 17572-1:2015.

3.16**lineare Referenzierung**

(en: linear referencing)

Spezifikation einer *Position* relativ zu einem *linearen* Element als seine Messung entlang dieses Elementes

Anmerkung 1 zum Begriff: In Anlehnung an EN ISO 19148:2012.

3.17**Position**

(en: location)

identifizierbarer geografischer Ort

[QUELLE: EN ISO 19112:2005]

Anmerkung 1 zum Begriff: Er ist entweder auf einem Netzwerk (als Punkt oder lineare Position) oder ein Gebiet. Er kann in einem oder mehreren Referenzsystemen unterstützt werden.

3.18**Positionscod**

(en: location code)

tabellarische Adresse von vorgeschichteten Positionsdetails in einer Positionstabelle, welche von einem Informationsanbieter verwendet wird

Anmerkung 1 zum Begriff: In Anlehnung an EN ISO 14819-3:2013, da diese hauptsächlich auf ALERT-C bezogen ist.

3.19**Positionsreferenz****Referenz**

(en: location reference

reference)

einer Position zugeordnete Datenmenge

Anmerkung 1 zum Begriff: Eine Referenz muss eine Position eindeutig und genau in einem Positionsreferenzsystem definieren. Die Referenz ist eine Datenmenge, welche zwischen verschiedenen unterschiedlichen Implementierungen weitergeleitet wird. Dabei wird dasselbe Positionsreferenzsystem zur Feststellung der Position verwendet.

3.20**Positionsreferenzsystem**

(en: location reference system)

LRS

Referenzsystem

vollständiges System, mit dem die Positionsreferenz nach einer Positionsreferenzmethode generiert und kommuniziert wird, wobei Standards, Definitionen, Software, Hardware und Datenbanken beinhaltet sind

[QUELLE: ISO 17572-1:2015]

3.21

Länge

geodätische Länge

(en: longitude
geodetic longitude)

Winkel von der primären meridianen Fläche zur meridianen Fläche des gegebenen Punktes, nach Osten positiv bewertet

Anmerkung 1 zum Begriff: In Anlehnung an ISO 19111:2007.

3.22

Punkt

(en: point)

zweidimensionales Element, welches eine geometrische Position definiert

[QUELLE: ISO 17572-1:2015]

3.23

Sehenswürdigkeit

(en: point of interest)

POI

spezifischer Ort der als Interessant angesehen wird

BEISPIEL Ein Punkt auf der Erde, der die Position eines Monumentes oder eines Hotels, Campingplätze, Tankstellen oder eine beliebige andere Kategorie, welche oft in Navigationssystemen verwendet wird, darstellt.

Anmerkung 1 zum Begriff: Eine Sehenswürdigkeit liegt außerhalb des Straßennetzes. Die Zufahrt ist ein Punkt im Straßennetzwerk, der den Zugang zur Sehenswürdigkeit ermöglicht.

3.24

Polygon

(en: polygon)

ebene Fläche, welche von einer äußeren Grenze und keiner oder mehreren inneren Grenzen festgelegt ist

[QUELLE: EN ISO 19136:2009]

3.25

vordefinierte Position

(en: predefined location)

Position, welche einen eindeutigen Bezeichner (Referenz) benutzt, der für den Sender und den Empfänger abgestimmt ist, um eine Position aus einer Menge von ausgetauschten Positionen selektieren zu können

Anmerkung 1 zum Begriff: In Anlehnung an ISO 17572-1:2015.

3.26

primärer Punkt

(en: primary point)

Punkt, welcher das Ende einer linearen Straßensektion trifft, wenn in die Positionsrichtung gefahren wird

Anmerkung 1 zum Begriff: Im Falle eines mit einem Ereignis betroffenen Gebietes zeigt der Punkt normalerweise auf das Ereignis (EN ISO 14819-3).

3.27

Referenz

(en: referent)

bekannte *Position*, von der aus eine relative Messung entlang eines linearen Elementes gemacht wurde

Anmerkung 1 zum Begriff: In Anlehnung an EN ISO 19148:2012.

3.28

sekundärer Punkt

(en: secondary point)

Punkt, der zum ersten Mal getroffen wird, wenn eine lineare Straßensektion nach der Positionsrichtung gefahren wird

3.29

Tupel

(en: tuple)

Liste sortierter Werte

[QUELLE: EN ISO 19136:2009]

Anmerkung 1 zum Begriff: Berücksichtigte Werte sind hier geodätische Koordinaten.

— Leerseite —

English Version

Intelligent transport systems - DATEX II data exchange
specifications for traffic management and information -
Part 2: Location referencing

Intelligente Verkehrssysteme - DATEX II
Datenaustauschspezifikation für Verkehrsmanagement
und Verkehrsinformationen - Teil 2:
Ortsreferenzierung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 278.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 16157-2:2017) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This document is currently submitted to the CEN Enquiry.

This document will supersede CEN/TS 16157-2:2011.

The major differences introduced in the new edition of this part are the following:

- introduction of a new location referencing system based on ISO/PRF TS 21219-22 “OpenLR™”;
- introduction of a new location referencing g system for linear features based on GML LineString;
- introduction of features to deal with 3D coordinates and accuracy assessment;
- flexibility when using linear referencing systems;
- remodelling of the “PredefinedLocationsPublication”;
- correction of different bugs.

prEN 16157-2 is the second part of the EN 16157 series, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information*; the other parts are:

- *Part 1: Context and Framework*;
- *Part 3: Situation Publication*;
- *Part 4: Variable Message Sign (VMS) Publications*;
- *Part 5: Measured and elaborated data publications*;
- *Part 6: Parking Publications*;
- *Part 7: Common data elements*.

Other parts will be developed in the future.

Introduction

This European Standard defines a common set of data exchange specifications to support the vision of a seamless interoperable exchange of traffic and travel information across boundaries, including national, urban, interurban, road administrations, infrastructure providers and service providers. Standardization in this context is a vital constituent to ensure interoperability, reduction of risk, reduction of the cost base, promotion of open marketplaces and many social, economic and community benefits to be gained from more informed travellers, network managers and transport operators.

Delivering European Transport Policy in line with the White Paper issued by the European Commission requires co-ordination of traffic management and development of seamless pan European services. With the aim to support sustainable mobility in Europe, the European Commission has been supporting the development of information exchange mainly between the actors of the road traffic management domain for a number of years. In the road sector, DATEX II has been long in fruition, with the European Commission being fundamental to its development through an initial contract and subsequent co-funding through the Euro-Regional projects. With this standardization of DATEX II, there is a real basis for common exchange between the actors of the traffic and travel information sector.

This European Standard includes the framework and context for exchanges, the modelling approach, data content, data structure and relationships.

This European Standard supports a methodology that is extensible.

This Part, Part 2 of this European Standard, deals with DATEX II location referencing. It references existing location referencing Standards or European Standards.

The European Committee for Standardization (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning procedures, methods and/or formats given in this document.

CEN takes no position concerning the evidence, validity and scope of patent rights.

1 Scope

This European Standard series (EN 16157) specifies and defines component facets supporting the exchange and shared use of data and information in the field of traffic and travel.

The component facets include the framework and context for exchanges, the modelling approach, data content, data structure and relationships.

This European Standard series is applicable to:

- traffic and travel information which is of relevance to road networks (non-urban and urban),
- public transport information that is of direct relevance to the use of a road network (e.g. road link via train or ferry service),
- traffic and travel information in the case of Cooperative intelligent transport systems (C-ITS).

This European Standard series establishes specifications for data exchange between any two instances of the following actors:

- Traffic Information Centres (TICs),
- Traffic Control Centres (TCCs),
- Service Providers (SPs).

Use of this European Standard series may be applicable for use by other actors.

This European Standard series covers, at least, the following types of informational content:

- road traffic event information – planned and unplanned occurrences both on the road network and in the surrounding environment,
- operator initiated actions,
- road traffic measurement data, status data, and travel time data,
- travel information relevant to road users, including weather and environmental information,
- road traffic management information and instructions relating to use of the road network.

This part of the EN 16157 series specifies the informational structures, relationships, roles, attributes and associated data types, for the implementation of the location referencing systems used in association with the different publications defined in the Datex II framework. It also defines a DATEX II publication for exchanging predefined locations. This is part of the DATEX II platform independent data model.

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.

prEN 16157-1:2017¹⁾, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 1: Context and Framework*

prEN 16157-7²⁾, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 7: Common data elements*

EN 16803-1, *Space — Use of GNSS-based positioning for road Intelligent Transport Systems (ITS) — Part 1: Definitions and system engineering procedures for the establishment and assessment of performances*

EN ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes (ISO 3166-1)*

EN ISO 14819-1, *Intelligent transport systems — Traffic and travel information messages via traffic message coding — Part 1: Coding protocol for Radio Data System — Traffic Message Channel (RDS-TMC) using ALERT-C (ISO 14819-1)*

EN ISO 14819-3:2013, *Intelligent transport systems — Traffic and travel information messages via traffic message coding — Part 3: Location referencing for Radio Data System — Traffic Message Channel (RDS-TMC) using ALERT-C (ISO 14819-3:2013)*

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

EN ISO 19136:2009, *Geographic information — Geography Markup Language (GML) (ISO 19136:2007)*

EN ISO 19148:2012, *Geographic information — Linear referencing (ISO 19148:2012)*

CEN ISO/TS 18234-6, *Traffic and Travel Information (TTI) — TTI via Transport Protocol Expert Group (TPEG) data-streams — Part 6: Location referencing applications (ISO/TS 18234-6)*

CEN ISO/TS 24530-2, *Traffic and Travel Information (TTI) — TTI via Transport Protocol Experts Group (TPEG) Extensible Markup Language (XML) — Part 2: tpeg-locML (ISO/TS 24530-2)*

ISO 3166-2, *Codes for the representation of names of countries and their subdivisions — Part 2: Country subdivision code*

ISO/IEC 19505-1, *Information technology — Object Management Group Unified Modeling Language (OMG UML) — Part 1: Infrastructure*

ISO/PRF TS 21219-22³⁾, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 22: OpenLR location referencing (TPEG2-OLR)*

1) Currently at Enquiry stage.

2) Currently at Enquiry stage.

ETSI/TS 102 894-2 V1.2.1 (2014-09), *Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 16157-1, prEN 16157-7 and the following apply.

3.1

area

two-dimensional, geographical region on the surface of the Earth

[SOURCE: ISO 17572-1:2015 [1]]

3.2

confidence ellipse

horizontal position accuracy in a shape of ellipse with a predefined confidence level (e.g. 95 %) the centre of which corresponds to the reference position point for which the position accuracy is evaluated

[SOURCE: ETSI/TS 102 894-2 V1.2.1 (2014-09)]

3.3

descriptor

characteristic of a geographic object, usually stored in an attribute

EXAMPLE Road names or road numbers.

3.4

destination

specification of the end point of a defined route or itinerary

Note 1 to entry: This may be either a location on a network or an area location.

3.5

ellipsoidal height

distance of a point from the ellipsoid measured along the perpendicular from the ellipsoid to point positive if upwards or outside of the ellipsoid

[SOURCE: EN ISO 19111:2007]

3.6

European terrestrial reference system 89

ETRS89

recommended terrestrial reference system for Europe and coincident with *ITRS* at the epoch 1989.0

Note 1 to entry: Unlike *ITRS*, ETRS is centred on the stable part of the European plate and not subject to change due to continental drift in most of Europe.

3) Under development.

3.7

geodetic coordinate

one of the sequences of two (or three) numbers designating the position of a point, expressed in *geodetic latitude*, *geodetic longitude* and (in the three-dimensional case) *ellipsoidal* or *gravity-related height*

Note 1 to entry: Adapted from EN ISO 19111:2007.

3.8

gravity-related height

height dependent on the Earth's gravity field

[SOURCE: EN ISO 19111:2007]

3.9

grid

special instance of rectangle location given by a base rectangular shape that is its lower left cell multiplied to the North (by defining the number of rows) and to the East (by defining the number of columns)

3.10

ILOC descriptor

one of the three *descriptors* associated to an *ILOC* reference

3.11

international terrestrial reference system

ITRS

reference system for the earth derived from precise and accurate space geodesy measurements, not restricted to GPS Doppler measurements, which is periodically tracked and revised by the International Earth Rotation Service (I.E.R.S.)

[SOURCE: ISO 17572-1:2015]

3.12

itinerary

group of one or more physically separate locations arranged as an ordered set that defines a route

3.13

latitude

geodetic latitude

angle from the equatorial plane to the perpendicular to the Earth through a given point, northwards treated as positive

Note 1 to entry: Adapted from EN ISO 19111:2007.

3.14

line string

curve composed of straight-line segments

[SOURCE: EN ISO 19136:2009]

3.15

linear

having a one-dimensional character

Note 1 to entry: Adapted from ISO 17572-1:2015.

3.16

linear referencing

specification of a *location* relative to a *linear* element as a measurement along that element

Note 1 to entry: Adapted from EN ISO 19148:2012.

3.17

location

identifiable geographic place

[SOURCE: EN ISO 19112:2005]

Note 1 to entry: It is either on a network (as a point or a linear location) or an area. This may be provided in one or more *referencing systems*.

3.18

location code

tabular address of the pre-stored *location* details in the *location* table used by the information provider

Note 1 to entry: Adapted from EN ISO 14819-3:2013 as it is mainly associated to ALERT-C.

3.19

location reference

reference

data set assigned to a *location*

Note 1 to entry: A reference unambiguously defines one location in the location referencing system. The reference is the set of data which is passed between different implementations using the same location referencing system to identify the location.

3.20

location referencing system

LRS

referencing system

complete system by which location references are generated, according to a location referencing method, and communicated, including standards, definitions, software, hardware, and databases

[SOURCE: ISO 17572-1:2015]

3.21

longitude

geodetic longitude

angle from the prime meridian plane to the meridian plane of a given point, eastward treated as positive

Note 1 to entry: Adapted from EN ISO 19111:2007.

3.22

point

zero-dimensional element that specifies a geometric location

[SOURCE: ISO 17572-1:2015]

3.23

point of interest

POI

specific point location that is thought useful or interesting

EXAMPLE A point on the Earth's representing the location of a monument or of hotels, campsites, fuel stations or any other categories often used in navigation systems.

Note 1 to entry: A POI sometimes lays out of the road network. An access point is a point on the road network in order to access this POI.

3.24

polygon

planar surface defined by one exterior boundary and zero or more interior boundaries

[SOURCE: EN ISO 19136:2009]

3.25

predefined location

location using a unique identifier (reference) that is agreed upon in both sender and receiver system to select a location from a set of locations already exchanged

Note 1 to entry: Adapted from ISO 17572-1:2015.

3.26

primary point

point met last when a linear road section when it is travelled according to the location direction

Note 1 to entry: In case of an affected linear with an event it generally pinpoints the origin of the event (EN ISO 14819-3).

3.27

referent

known *location* from which relative measurement are made along a linear element

Note 1 to entry: Adapted from EN ISO 19148:2012.

3.28

secondary point

point met first when a linear road section is travelled according to the location direction

3.29

tuple

ordered list of values

[SOURCE: EN ISO 19136:2009]

Note 1 to entry: Considered values are here geodetic coordinates.

4 Symbols and abbreviations

For the purpose of this document, the following abbreviations apply throughout the document unless otherwise specified.

ALERT-C Alert and problem location for European road traffic, version C

C-ITS	Cooperative intelligent transport systems
DNP	Distance to next point
FOW	Form of way
FRC	Functional road class
GIS	Geographic information system
GML	Geographic markup language
GPS	Global positioning system
ILOC	Intersection location

NOTE 1 It is the basis of a dynamic referencing system named “ILOC referencing system”, subsequently adopted by TPEG as “TPEG-Loc”.

LR	Linear referencing
LRM	Linear referencing method
OpenLR	Open location referencing

NOTE 2 It is a trade mark of the TomTom BV company (see <http://www.openlr.org>).

TPEG	Transport protocol expert group
TPEG2	Transport protocol expert group, generation 2

5 Conformance

The DATEX II platform independent data model of which the location referencing packages as well as Predefined Locations Publication sub-model are parts, corresponds to the Level A model as defined in prEN 16157-1.

Conformance with this Part shall require platform independent models from which platform specific models are generated to comply with the UML modelling rules defined in prEN 16157-1 and with the following requirements of this sub-model which are expressed in this Part:

- comply with all stipulated minimum and maximum multiplicity requirements for UML elements and relationships;
- comply with all definitions, types and ordering;
- employ optional elements as specified;
- comply with all expressed constraints.

It should be noted that conformance of a publication service with all the structural requirements stated above does not necessarily ensure that the informational content of that service will be semantically comprehensible.

6 UML notation

The UML notation used in this European Standard shall be as described in ISO/IEC 19505-1.

NOTE Some introduction guides to UML 2 are provided in the Bibliography of prEN 16157-1:2017.

7 The DATEX II location referencing model

7.1 General

The normative Annex A provides the data dictionary i.e. a comprehensive view of the different classes, attributes and associations for each package. Each subclause corresponds to a package.

The types of attribute and the enumerations specific to this part are defined in the normative Annex A.

The XML subschema corresponding to this part of EN 16157 is provided in the normative Annex B.

The informative Annex C provides some explanations about the location referencing methods that are relevant for this part of EN 16157, some of them being drawn from approved standards like those on linear referencing or on ALERT-C.

7.1.1 The package “LocationReference”

7.1.1.1 The overall model

The package “LocationReference” supplies classes and attributes to the definition of a *location* locating a traffic object e.g. a situation record in a situation publication. It is pictured including the relationships between the classes in Figure 1.

This contributes important information in the different publications derived from the “PayloadPublication” defined in prEN 16157-7, bringing information on “where” in each case.

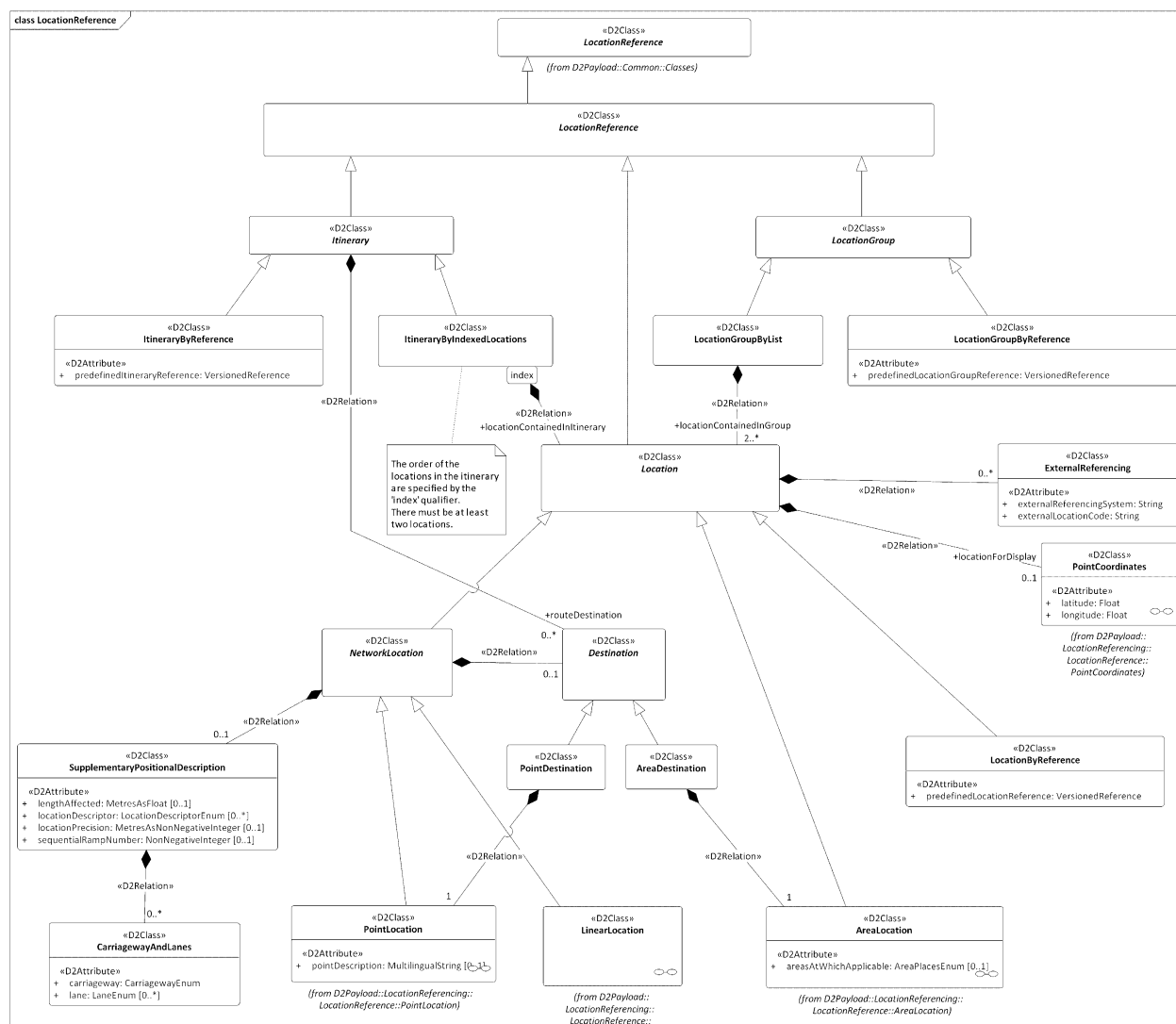


Figure 1 — DATEX II location referencing model

7.1.1.2 Semantics

The most generic concept, the *location reference*, is a set of one or several locations and is depicted by the abstract class “LocationReference” that is the main entry point of the corresponding package to carry the corresponding locations. The class is a subclass of Common::Classes::LocationReference that is defined in prEN 16157-7 as explained in the following class diagram.

This location reference can be either used as a set of locations that can be seen independently one from another and without any order (class “LocationGroup”) or as an *itinerary* (or route) (class “Itinerary”) or a single *location* (depicted by the class “Location”), which is the atomic locating unit. In the case of an *itinerary* the different sections defining it shall be defined following a specific order or linkage.

Any location reference (i.e. an *itinerary* or a group of non-ordered *locations* or single *location*) can be predefined i.e. previously defined, identified and exchanged and then be used through its *reference* (respectively class “ItineraryByReference”, class “LocationGroupByReference” and class “LocationByReference”).

A group of non-ordered *locations* as well as an *itinerary* have at least two *locations*.

A *location* can be either:

- a road network element (class “NetworkLocation”),
- an *area* (class “AreaLocation”).

A road network *location* can be either a *linear* or a *point* location (respectively classes “LinearLocation” and “PointLocation”). The possible description of them is realized in the corresponding packages. The *area* description is realized in the “AreaLocation” package.

In case of an *itinerary* destination(s) may be added to it through occurrence(s) of the class “Destination”. A destination can be delineated either as a *point* on the road network (class “PointDestination” defined from the class “PointLocation”) or as an *area* (class “AreaDestination” defined from the class “AreaLocation”).

To help the *location* to be displayed on a map, *geodetic coordinates* (in term of *geodetic longitude* and *geodetic latitude*) may be added (class “PointCoordinates”).

External *references* may be added to *locations* if there is a need to add a reference to an external/other *referencing system* (class “ExternalReferencing”). The given *reference* code provided shall be accompanied with the name of the external *referencing system* in use. For example, this feature may be used to extend the present model accordingly to prEN 16157-1.

7.1.1.3 Semantics of supplementary positional information

Supplementary positional information may be added to a road network element for describing the transversal position of the element to be located on the road (class “SupplementaryPositionalDescription”). Therefore, it is possible to globally define the sequential ramp number, the minimum accuracy (in metres) which may qualify the corresponding location or to textually qualify this location (e.g. “on bridge”).

Besides it may be completed by transverse positional information (class “CarriagewayAndLanes”) with the exact carriageway(s), with for each the corresponding lane(s) and the affected length.

7.1.2 The package “TpegDescriptor”

7.1.2.1 The class model

The package “TpegDescriptor” supplies classes and attributes to the definition of a *descriptor* in TPEG which delineates the descriptive part of a TPEG location besides *geodetic coordinates*. It is pictured including the relationships between the classes in Figure 2.

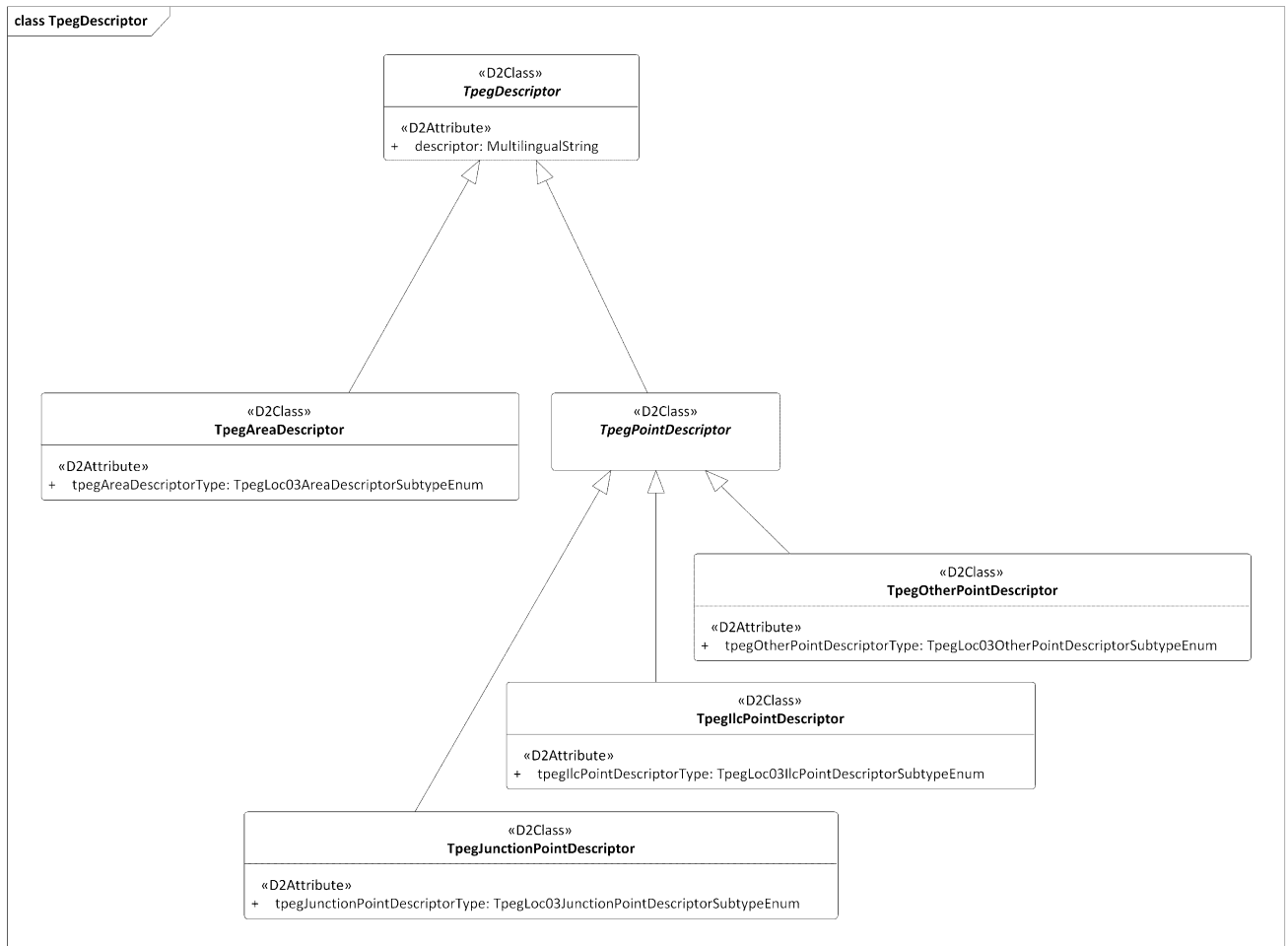


Figure 2 — The “TpegDescriptor” package class model

7.1.2.2 Semantics

A *descriptor* is a TPEG-originated word representing any textual description and shall be composed of a descriptor type, a text string and a language code. The latter two elements shall be embedded in a “MultilingualString” structure.

Different *descriptors* are provided for areas and for points. The corresponding *descriptor* types are defined in different enumerations in A.4.

7.2 Point locations

7.2.1 The package “PointLocation”

7.2.1.1 The class model

The package “PointLocation” supplies classes and attributes to the definition of a *point location* which specializes a *location* of a traffic object. It is pictured including the relationships between the classes in Figure 3.

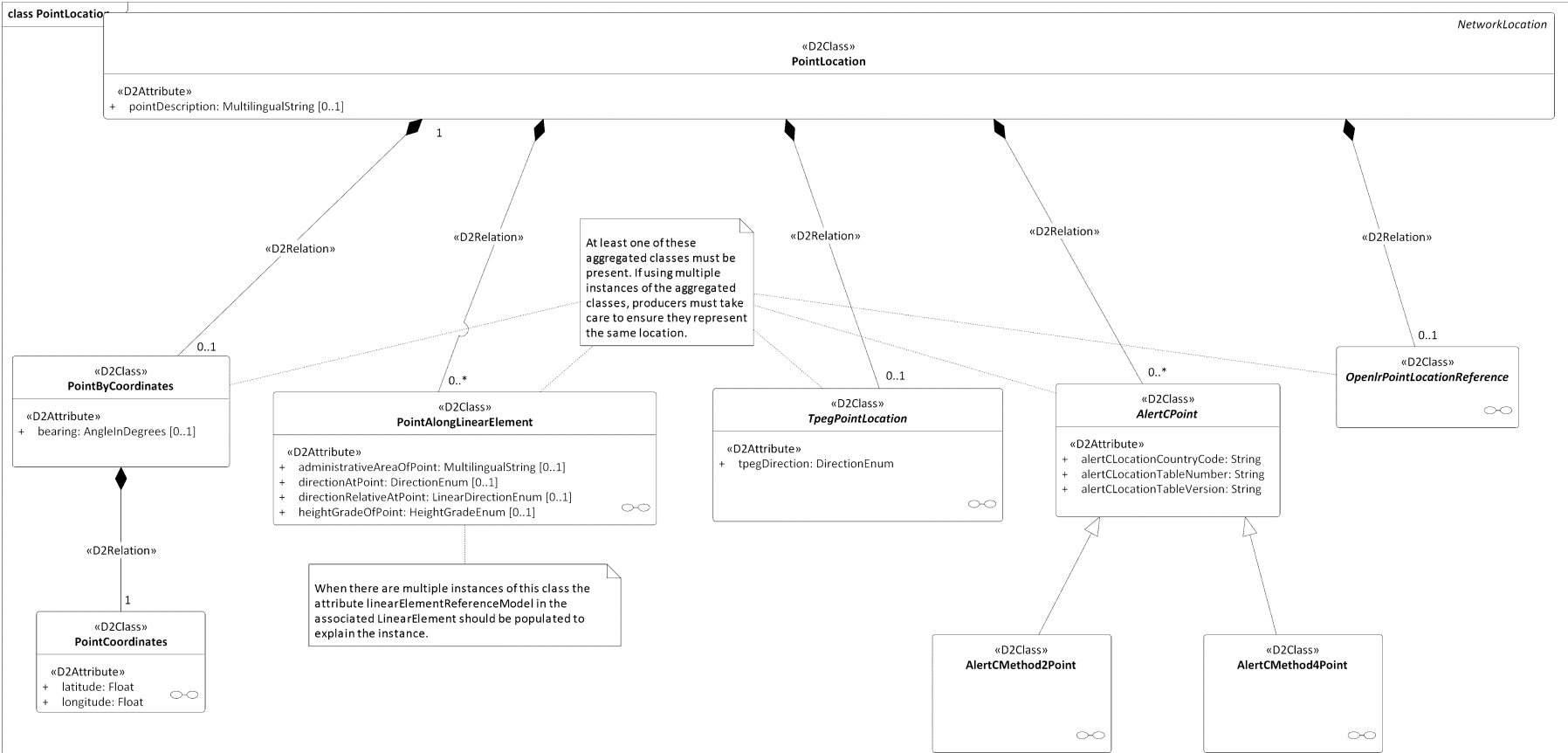


Figure 3 — The “PointLocation” package class model

7.2.1.2 Semantics

A point network element (class “PointLocation”) represents a single geospatial point on a road. It shall be referenced using at least one of the following six methods:

- the ALERT-C location referencing methods (class “AlertCPoint”);
- the TPEG-Loc location referencing method (class “TpegPointLocation”). This method is defined in 7.2.4 below;
- the linear referencing method (class “PointAlongLinearElement”). This method is defined in 7.2.5;
- the OpenLR™ location referencing method (class “OpenlrPoint”). This method is defined in 7.2.7;
- A geographic point defined with geodetic coordinates. It may include a bearing (class “PointByCoordinates”). The other attributes are defined in the package “PointCoordinates” (see 7.2.4).

When a point location is defined using different methods it is assumed to represent the same geographic location. As well, a point defined by the linear referencing method may be associated with different instances, each one associated to a reference model through the attribute “LinearElement::linearElementReferentModel” (see 7.2.6) but representing the same geographic feature.

There are two methods based on ALERT-C. If AlertCPoint is chosen the method shall be one of:

- a point simply defined by a reference in an ALERT-C location table (class “AlertCMethod2Point”);
- a point defined by a reference in an ALERT-C location table with a distance between the ALERT-C point and the actual point (class “AlertCMethod4Point”).

Each of them shall have an associated direction of traffic flow. These methods are respectively defined in 7.2.2 and in 7.2.3. An ALERT-C point can be defined several times, each definition being associated to a unique triple: country code, table number and version number.

7.2.2 The package “AlertCMethod2Point”

7.2.2.1 The class model

The package “AlertCMethod2Point” supplies classes and attributes to the definition of a *point location* using the method 2 as explained in EN ISO 14819-3:2013, Annex C. It is pictured including the relationships between the classes in Figure 4.

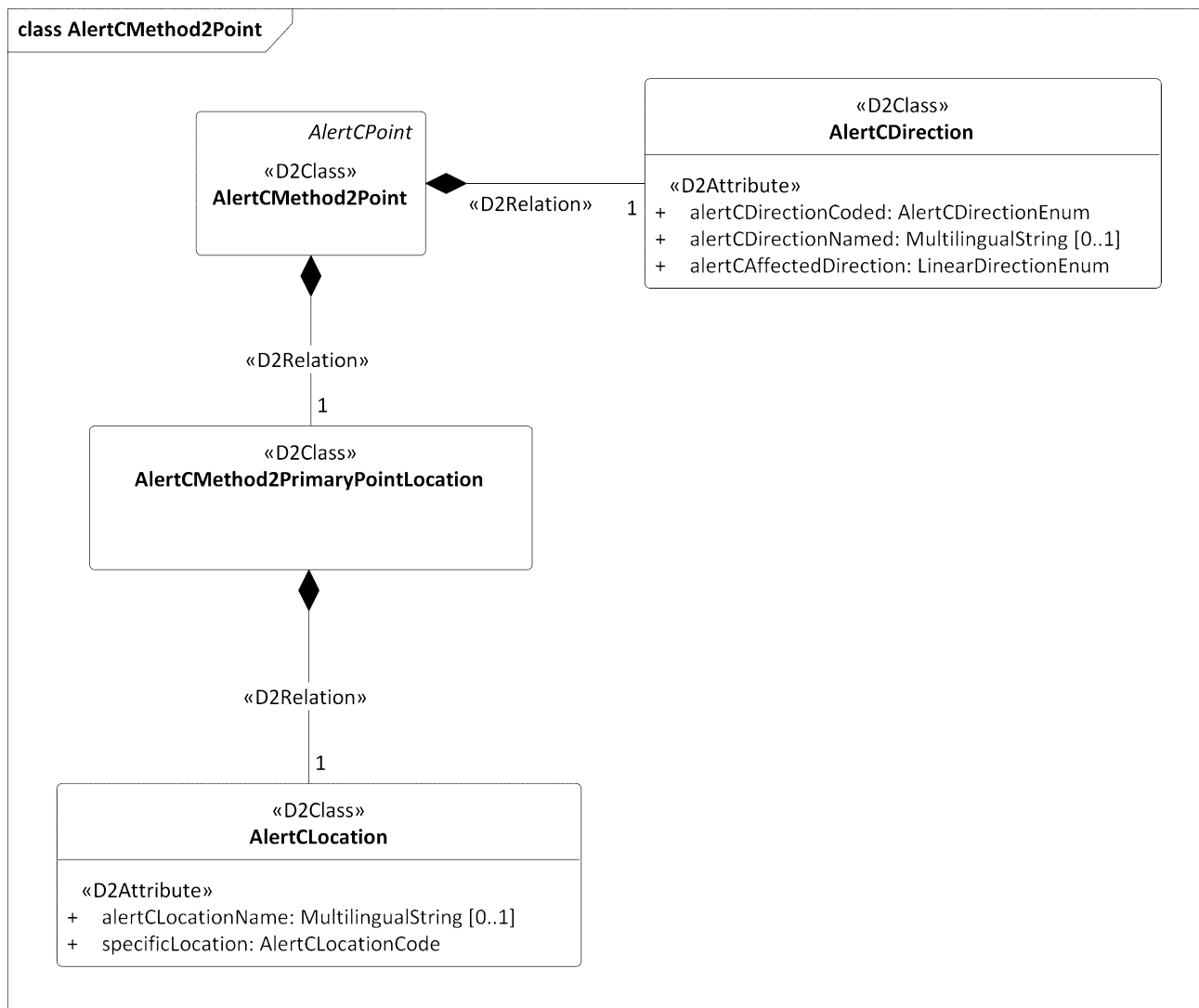


Figure 4 — The “AlertCMethod2Point” package class model

7.2.2.2 Semantics

An ALERT-C point using method 2 (class “AlertCMethod2Point”) represents a single point on the road network defined by reference to a point in a pre-defined ALERT-C location table (class “AlertCMethod2PrimaryPointLocation”). This point is called *primary point*. It also has an associated direction of traffic flow representing the direction of traffic flow along the road to which the information relates (class “AlertCDirection”).

The ALERT-C point location is given an ALERT-C direction using a set of predefined coded values. The attribute “alertCDirectionCoded” is used to define which offset type (i.e. negative or positive) is used to navigate in the ALERT-C location table. The attribute “alertCAffectedDirection” specifies the driving direction(s) affected by the traffic object. A name may also be added to complete the direction definition.

7.2.3 The package “AlertCMethod4Point”

7.2.3.1 The class model

The package “AlertCMethod2Point” supplies classes and attributes to the definition of a *point location* using the method 4 as explained in EN ISO 14819-3:2013, Annex C. It is pictured including the relationships between the classes in Figure 5.

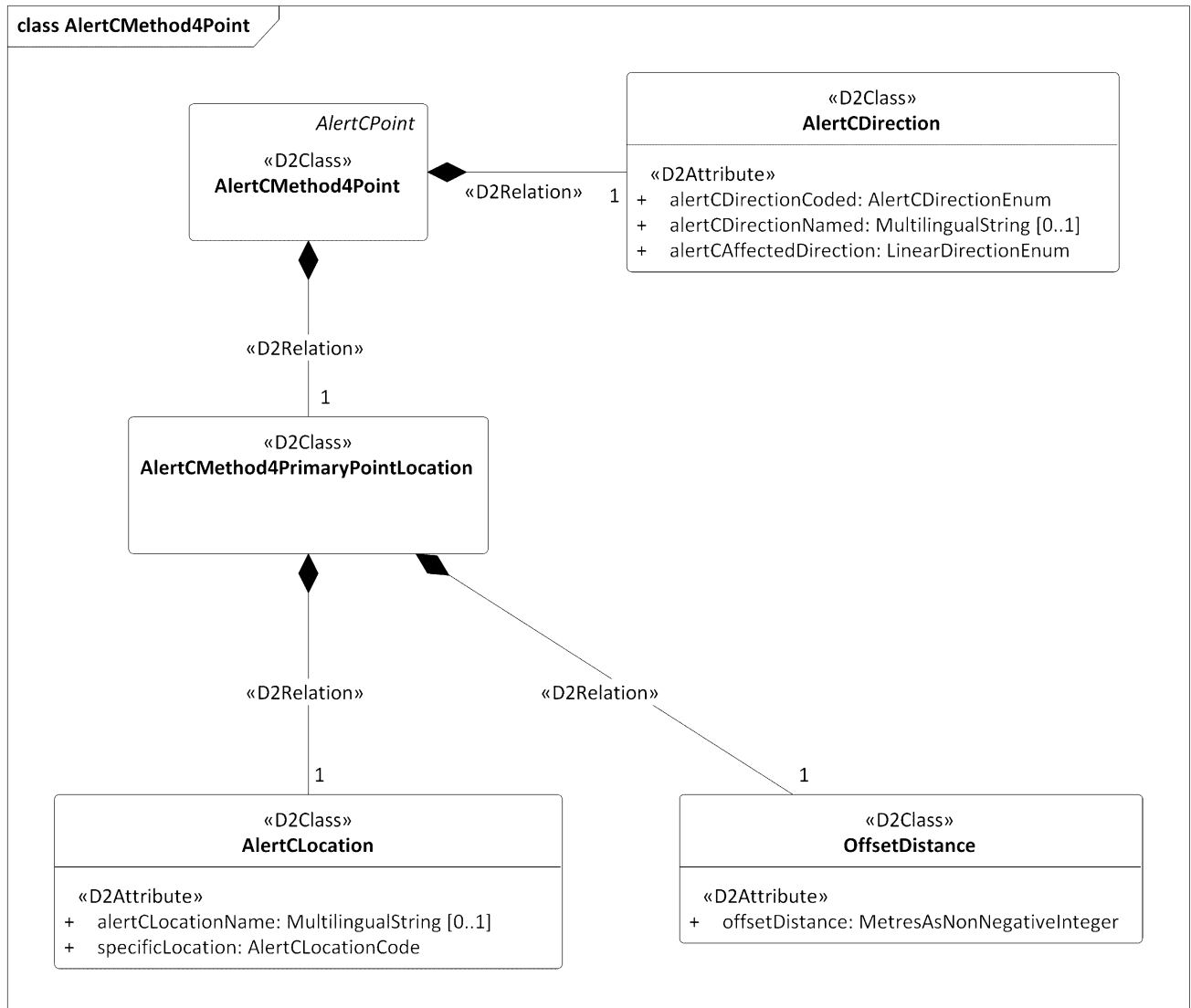


Figure 5 — The “AlertCMethod4Point” package class model

7.2.3.2 Semantics

An ALERT-C point using method 4 (class “AlertCMethod4Point”) represents a single point on the road network as defined by reference to a point in a pre-defined ALERT-C location table (class “AlertCMethod2PrimaryPointLocation”). It shall be augmented with the non-negative distance in metres between the ALERT-C point and the actual referenced point (class “OffsetDistance”). This point is called *primary point*. It also has an associated direction of traffic flow representing the direction of traffic flow along the road to which the information relates (class “AlertCDirection”).

The ALERT-C point location is given an ALERT-C direction using a set of predefined coded values. The attribute “alertCDirectionCoded” is used to define which offset type (i.e. negative or positive) is used to navigate in the ALERT-C location table. The attribute “alertCAffectedDirection” specifies the driving direction(s) affected by the traffic object. A name may also be added to complete the direction definition.

7.2.4 The package “PointCoordinates”

7.2.4.1 The class model

The package “PointCoordinates” supplies classes and attributes to the definition of a *point location* by coordinates including three-dimension definition and the corresponding confidence parameters. It is pictured including the relationships between the classes in Figure 6.

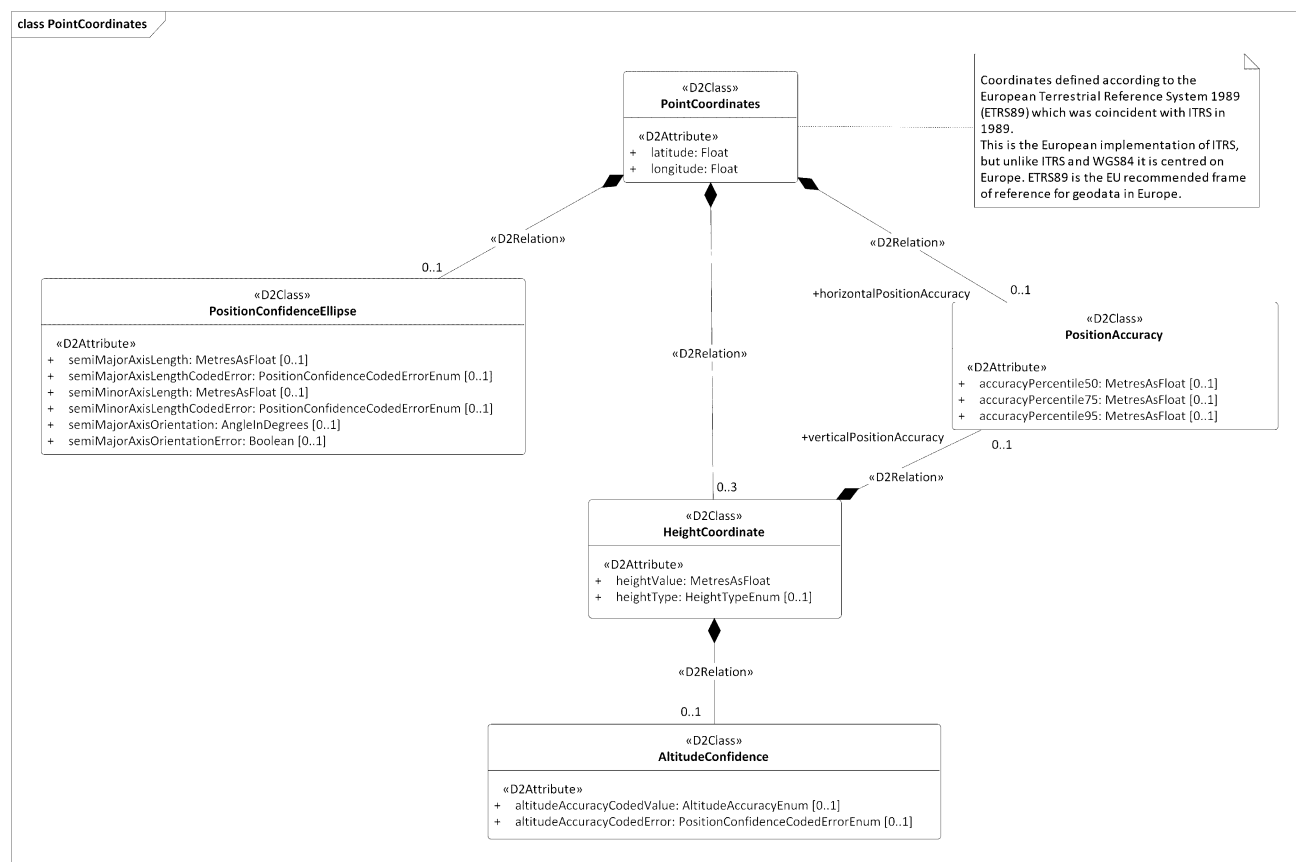


Figure 6 — The “PointCoordinates” class model

7.2.4.2 Semantics

In this package a point is defined by geodetic coordinates (in term of geodetic longitude and geodetic latitude) through the class “PointCoordinates”. Geodetic coordinates are defined according to the European Terrestrial Reference System of 1989 (ETRS89) which was coincident with the International Terrestrial Reference System (ITRS) in 1989. This is the European implementation of ITRS, but unlike ITRS it is fixed to the stable part of the Eurasian Plate. The coordinates and maps in Europe based on ETRS89 are not subject to change due to the continental drift. ETRS89 is the EU-recommended frame of reference for geodetic data in Europe.

In the case of three-dimension definition the third coordinate is added through the class “HeightCoordinate”. Three variants of height are proposed: by default, it is the *ellipsoidal height*

(measured relatively to the IERS ellipsoid). Other possibilities are *gravity-related height* (defined by a value measured along direction of gravity above the reference geoid i.e. equipotential surface of the Earth's gravity field which globally approximates mean sea level – often inaccurately named “altitude”) and relative height defined relatively to the ground level.

In addition, the classes “PositionConfidenceEllipse” and “AltitudeConfidence” can be used to defined the accuracy of the geographical position through a *confidence ellipse* and its height according to the specifications of ETSI/TS 102 894-2. This accuracy is based on a confidence level of 95 % (see ETSI/TS 102 894-2 V1.2.1 (2014-09), A.119 and A.8). The class “PositionAccuracy” is defined according to EN 16803-1.

7.2.5 The package “TpegPointLocation”

7.2.5.1 The class model

The package “TpegPointLocation” supplies classes and attributes to the definition of a *point location* using the methods described in CEN ISO/TS 18234-6 and CEN ISO/TS 24530-2. It is pictured including the relationships between the classes in Figure 7.

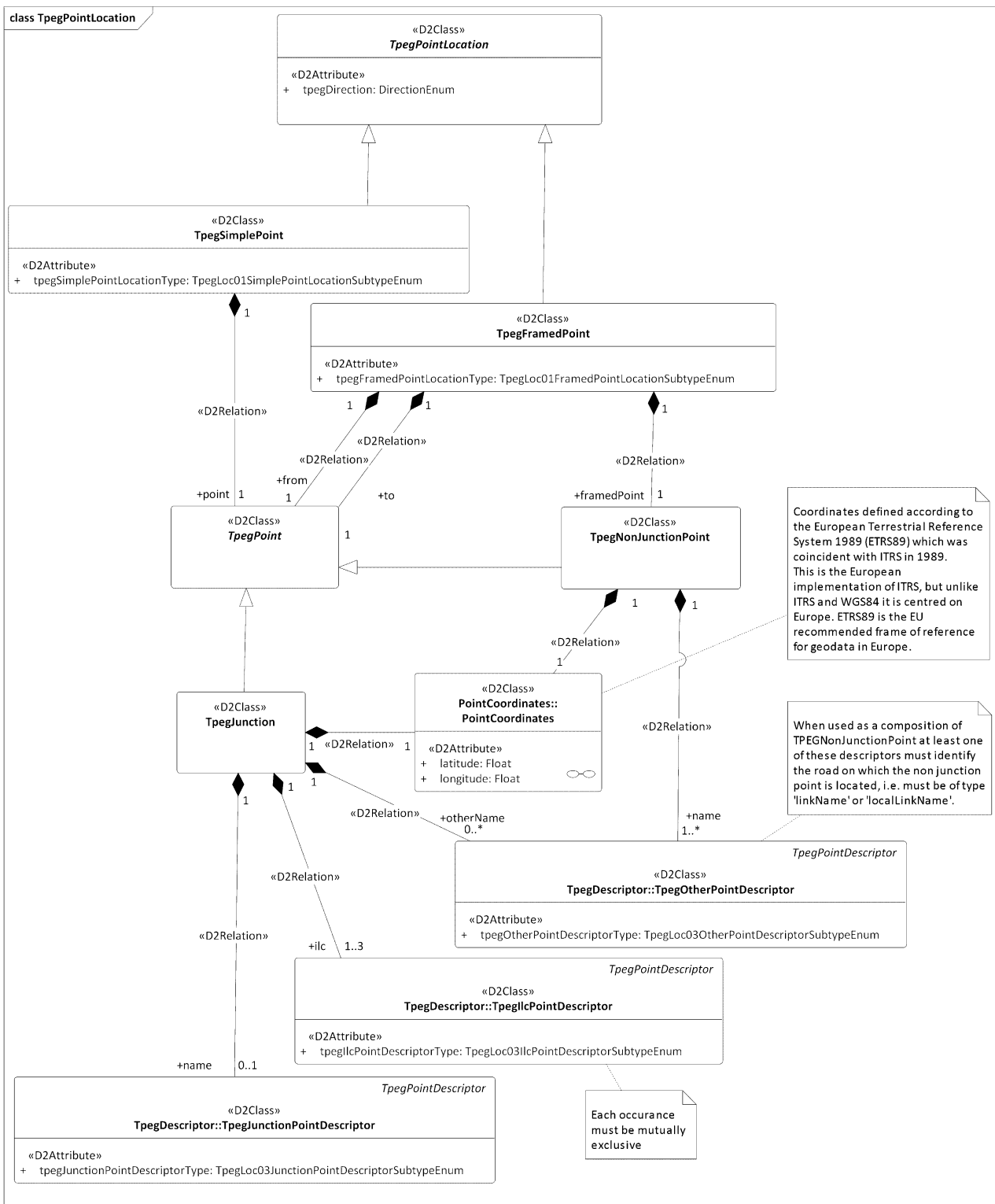


Figure 7 — The “TpegPointLocation” package class model

7.2.5.2 Semantics

A TPEG point represents a single point on the road network defined by a TPEG-Loc structure and shall have a direction of traffic flow. It shall be realized as:

- A simple point (class “TpegSimplePoint”) i.e. a point on the road network not bounded by any other points on the road network, or
- A framed point (class “TpegFramedPoint”) i.e. represents a point on the road network framed (or bracketed) between two other points on the same road. It can be used when the location is not at a junction and is a point without a predefined name. The two points at either side are used to frame the location with known points;

Points of one type or of the other have the common characteristics of all of TPEG points (class “TpegPoint”). They can be either located at a road junction (class “TpegJunction”) or located outside any road junction (class “TpegNonJunctionPoint”). They also include a *geodetic coordinate* pair as already defined in 7.1.1.2.

When a TPEG point is at a junction it shall be defined with one to three *ILOC descriptors* (class “TpegIlocPointDescriptor”). It may also be described with a *junction descriptor* (class “TpegJunctionPointDescriptor”) and/or with other *point descriptors* (class “TpegOtherPointDescriptor”). Regarding *ILOC descriptor* the different values of this descriptor shall be mutually exclusive.

When a TPEG point is not at a *junction* it shall be defined with at least one *point descriptor* (the class “TpegOtherPointDescriptor”). One of these descriptors shall identify the road or street on which the TPEG point is located. The corresponding descriptor type shall have either the value ‘linkName’ or the value ‘localLinkName’ (see in 7.1.2.2 and in A.4.18).

A TPEG framed point shall be defined by three TPEG points. In addition to the framed point that is not on a *junction*, it shall define other two points that frame the framed point.

The different *descriptors* are described in 7.1.2.2.

7.2.6 The package “PointAlongLinearElement”

7.2.6.1 The class model

The package “PointAlongLinearElement” supplies classes and attributes to the definition of a point *location* using different linear referencing methods as described in EN ISO 19148. It is pictured including the relationships between the classes in Figure 8.

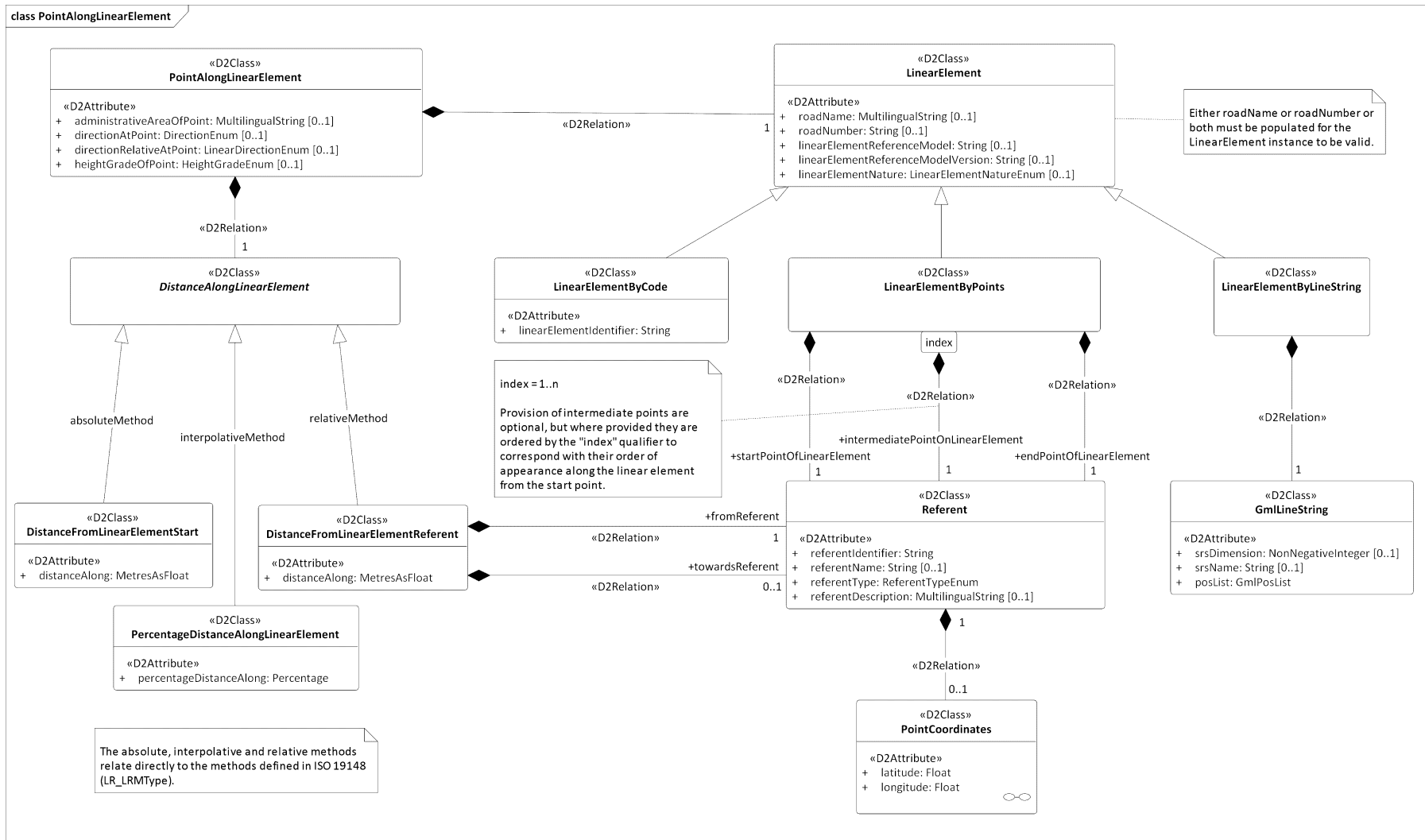


Figure 8 — The “PointAlongLinearElement” package class model

7.2.6.2 Semantics

A point defined by a *linear reference* represent a single point on a *linear* element, part of the road network. In addition to the *linear location* definition itself (class “PointAlongLinearElement”), which contains complementary elements like geographic direction, if the point is at-grade or below/above ground level, it shall be realized with two elements:

- The underlying *linear* element (class “LinearElement”),
- The distance expression between a given point on this *linear* element and the point itself (abstract class “DistanceAlongLinearElement”).

The distance expression shall be one of the following:

- An absolute distance expression i.e. a curvilinear measurement (in metres) starting from the origin point of the underlying linear element (class “DistanceFromLinearElementStart”);
- A percentage as distance expression i.e. the ratio between the absolute distance of the considered point from the starting point of the underlying linear element and the total length of this linear element (class “PercentageDistanceAlongLinearElement”).
- A relative distance expression i.e. a curvilinear measurement (in metres) starting from an identified point of the considered linear element considered as reference point (class “DistanceFromLinearElementReferent”). This reference point is named “Referent” (class “Referent”);

In case a *referent* is considered, it can be a distance marker (also named kilopost, kilometre-post or milepost), an area border (e.g. a county border), an intersection, a road node or a landmark. It is defined by a unique identifier. Two *referents* may be used to frame the considered point (notions of “from” *referent* and of “towards” *referent*), which explicitly defines the considered driving direction as going from the “from” *referent* to the “towards” *referent* and overrides the implicit direction defined by the underlying linear element direction. A *referent* may be given geodetic coordinates (class “PointCoordinates”).

The *linear* element that underlies the point *location* is defined by several means:

- A reference (class “LinearElementByCode”), which implies it has previously been defined and exchanged through the ad hoc publication (see Clause 8);
- An ordered sequence of *referents* including the starting point and the end point of this *linear* element (class “LinearElementByPoints”). In case the linear element is defined by *referents*, the sequence order provides the *linear* element direction.
- A linear geographic feature delineated by a *line string* (class “LinearElementByLineString” – see 7.3.8).

The *linear* element shall be given either a road number or a road name depending on what exists. It may be accompanied by other information depending on the road operator and may be typified i.e. defining whether it is a road, a road section or a slip road. In particular, the attribute “linearElementReferenceModel” shall be filled in case several instances of the class “PointAlongLinearElement” are created.

7.2.7 The package “OpenlrPoint”

7.2.7.1 The class model

The package “OpenlrPoint” supplies classes and attributes to the definition of a *point location* using the OpenLR™ method as explained in ISO/PRF TS 21219-22. It is pictured including the relationships between the classes in Figure 9.

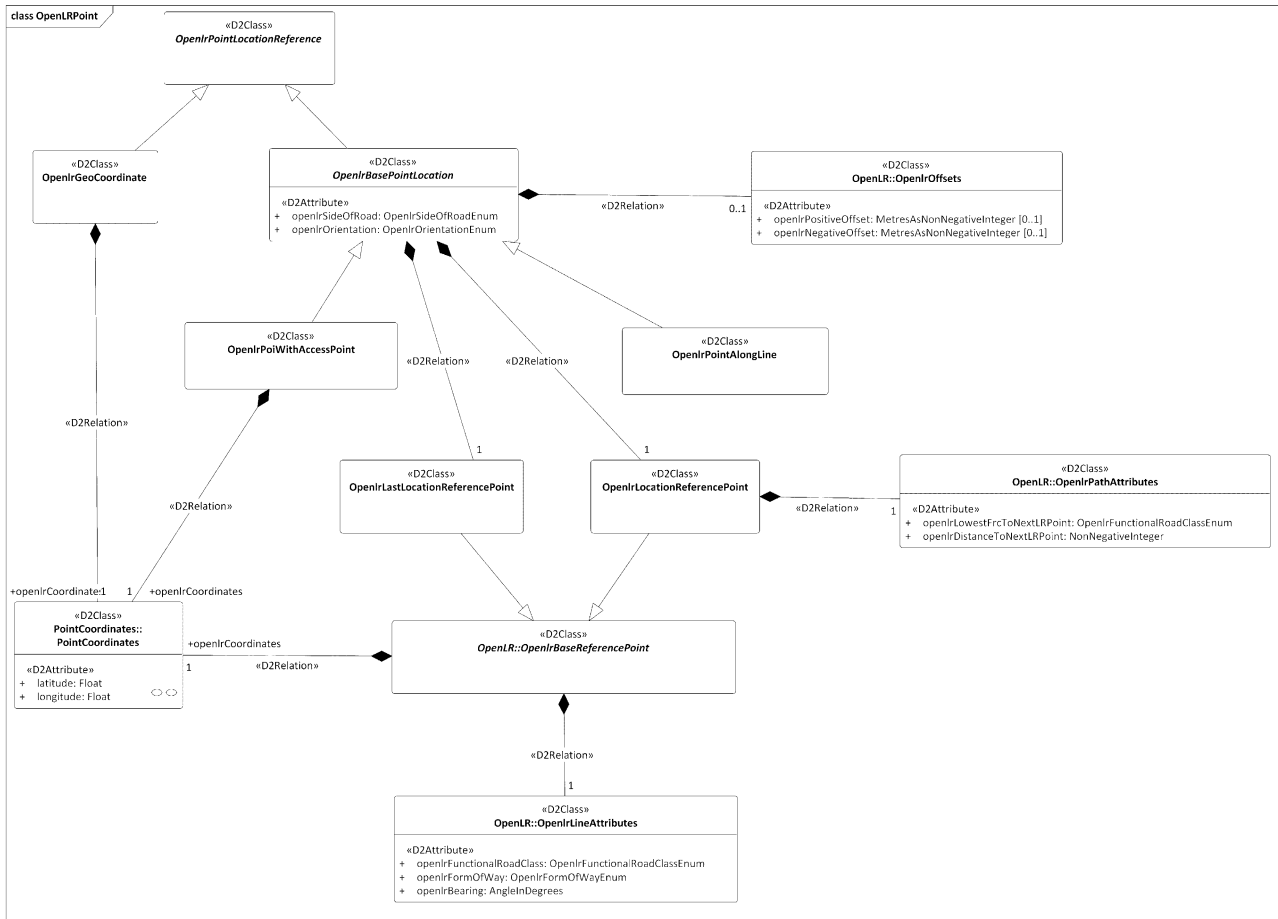


Figure 9 — The “OpenlrPoint” package class model

7.2.7.2 Semantics

An OpenLR™ point (class “OpenlrPointLocationReference”) represents a single point that can be either on the road network or defined by a simple pair of geodetic coordinates (class “OpenlrGeoCoordinate”). Being on a road network it can be defined either as a *point of interest (POI)* with an access point to the line reference path (class “OpenlrPoiWithAccessPoint”) or a point along a linear representing a road element (class “OpenlrPointAlongLine”).

Both classes representing points on a road network inherit of the “OpenlrBasePointLocation” class which defines a linear element, its orientation, the side of road where the located point lyes and a positive offset that represents the distance in meters between the node starting the linear path carrying the point and the point itself. The linear path is expressed by two points realized by respectively the classes “OpenlrLocationReferencePoint” and “OpenlrLastLocationReferencePoint”. These latter classes inherit from the “OpenlrBaseReferencePoint” class which is linked to geodetic coordinates

("PointCoordinates" class) and to attributes like bearing, form-of-way and functional road class through the class "OpenlrLineAttributes".

The package "LinearLocation" supplies classes and attributes to the definition of a *linear location* which specializes a *location* of a traffic object. It is pictured including the relationships between the classes in Figure 10.

7.3 Linear locations

7.3.1 The package “LinearLocation”

7.3.1.1 The class model

The package “LinearLocation” supplies classes and attributes to the definition of a *linear location* which specializes a *location* of a traffic object. It is pictured including the relationships between the classes in Figure 10.

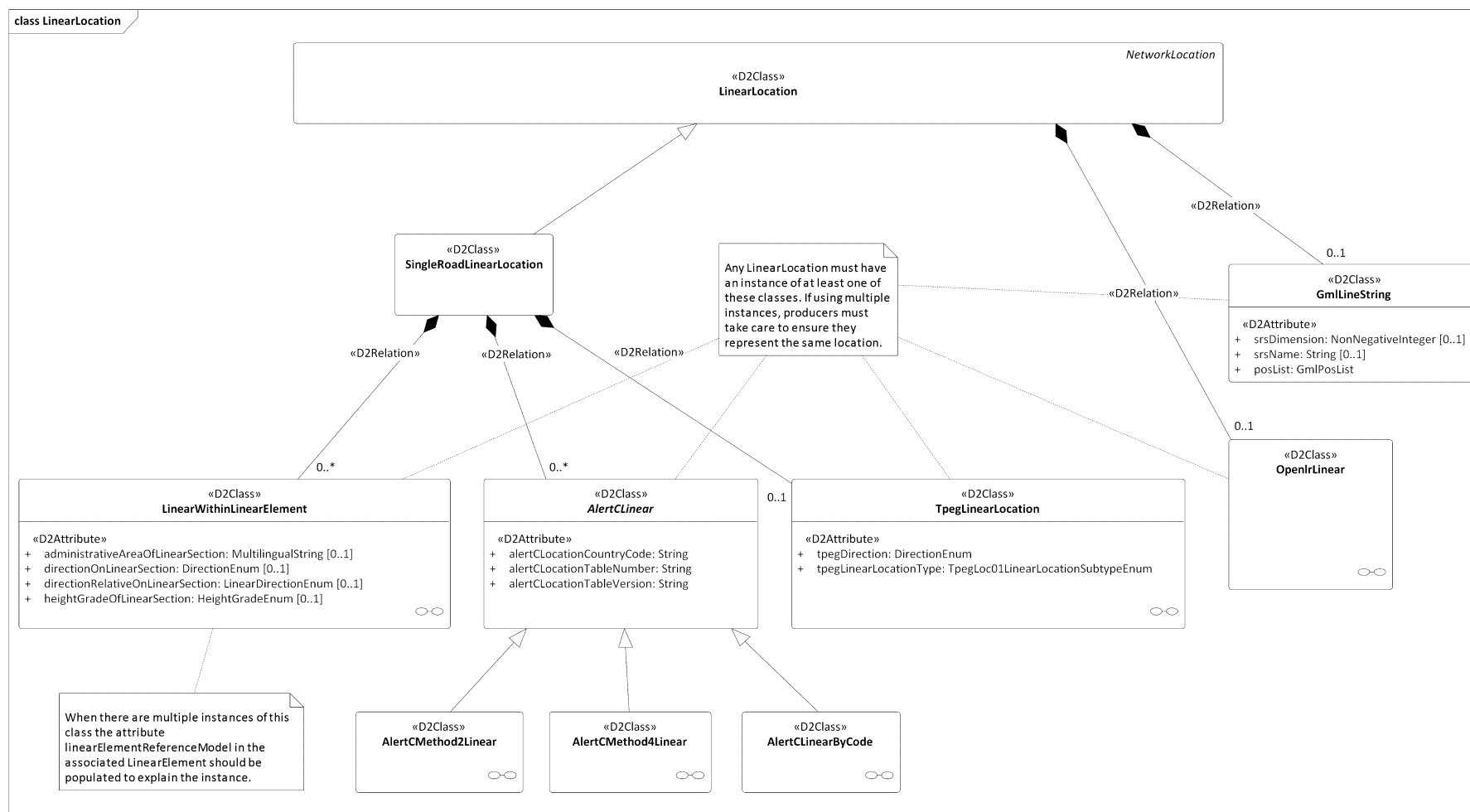


Figure 10 — The “LinearLocation” package class model

7.3.1.2 Semantics

A *linear* network element (class “LinearLocation”) is a part of the road network defined between two points on the same road. It may include an indication of direction. It shall be referenced using at least one of the following five methods:

- the ALERT-C location referencing methods (class “AlertCLinear”);
- the GML-based linear definition method (class “GmlLineString”);
- the TPEG-Loc location referencing method (class “TpegLinearLocation”);
- the *linear location* referencing method (class “LinearWithinLinearElement”);
- the OpenLR™ location referencing method (class “OpenlrLinear”).

These latter four methods are respectively defined in 7.3.8, 7.3.5, 7.3.6 and 7.3.7.

When a *linear location* is defined using different methods it is assumed to represent the same geographic location. As well, a *linear* location defined by the *linear* referencing method or an ALERT-C location method may be associated to different instances, each one associated to a reference model but representing the same geographic feature.

Some location referencing methods like OpenLR™ or GML allow defining *linear locations* that belong to several roads whereas some others not (like ALERT-C, TPEG or linear referencing). These latter *linear locations* are composed to the “SingleRoadLinearLocation” class, which is inherited from the “LinearLocation” class.

There are three methods based on ALERT-C. If AlertCLinear is chosen the method shall be one of:

- an ALERT-C linear entity defined as a reference in an ALERT-C location table (class “AlertCLinearByCode”);
- a linear section defined by two points defined by references in an ALERT-C location table (class “AlertCMethod2Linear”);
- a linear section defined by two points defined by references in an ALERT-C location table with a distance between the ALERT-C point and the corresponding start point / end point of the actual section (class “AlertCMethod4Linear”).

These methods are respectively defined in 7.3.4, 7.3.2 and 7.3.3. The ALERT-C *linear location* can be defined several times, each definition being associated to a unique triple: country code, table number and version number.

7.3.2 The package “AlertCMethod2Linear”

7.3.2.1 The class model

The package “AlertCMethod2Linear” supplies classes and attributes to the definition of a *linear location* using the method 2 as explained in EN ISO 14819-3:2013, Annex C. It is pictured including the relationships between the classes in Figure 11.

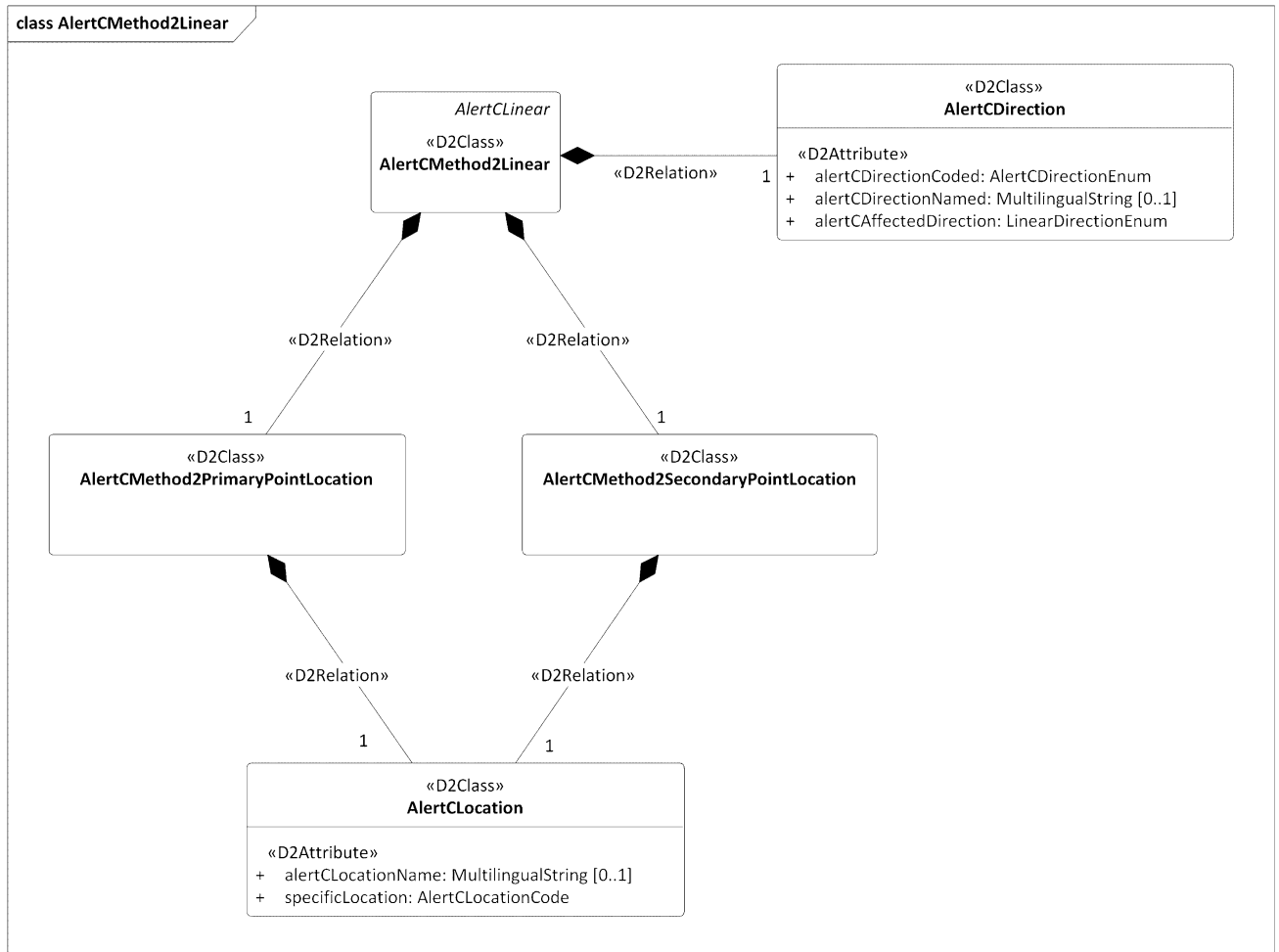


Figure 11 — The “AlertCMethod2Linear” package class model

7.3.2.2 Semantics

An ALERT-C *linear location* reference using method 2 (class “AlertCMethod2Linear”) represents a linear section along a road between two points, *primary* and *secondary*, which are pre-defined in an ALERT-C location table. Direction is from the *secondary* point (class “AlertCMethod2SecondaryPointLocation”) to the *primary* point (class “AlertCMethod2PrimaryPointLocation”), i.e. the *secondary* point is first met before the *primary* point when the road section is travelled in the location direction.

It shall have an associated direction of traffic flow representing the direction of traffic flow along the road to which the information relates (class “AlertCDirection”).

The ALERT-C *linear location* reference is given an ALERT-C direction using a set of predefined coded values. The attribute “alertCDirectionCoded” is used to define which offset type (i.e. negative or positive) is used to navigate in the ALERT-C location table. The attribute “alertCAffectedDirection” specifies the driving direction(s) affected by the traffic object. In case of a ring road, the “alertCDirectionCoded” attribute is used to remove the ambiguity how to reach the *primary* point from the *secondary* point. A name may also be added to complete the direction definition.

7.3.3 The package “AlertCMethod4Linear”

7.3.3.1 The class model

The package “AlertCMethod4Linear” supplies classes and attributes to the definition of a *linear location* using the method 4 as explained in EN ISO 14819-3:2013, Annex C. It is pictured including the relationships between the classes in Figure 12.

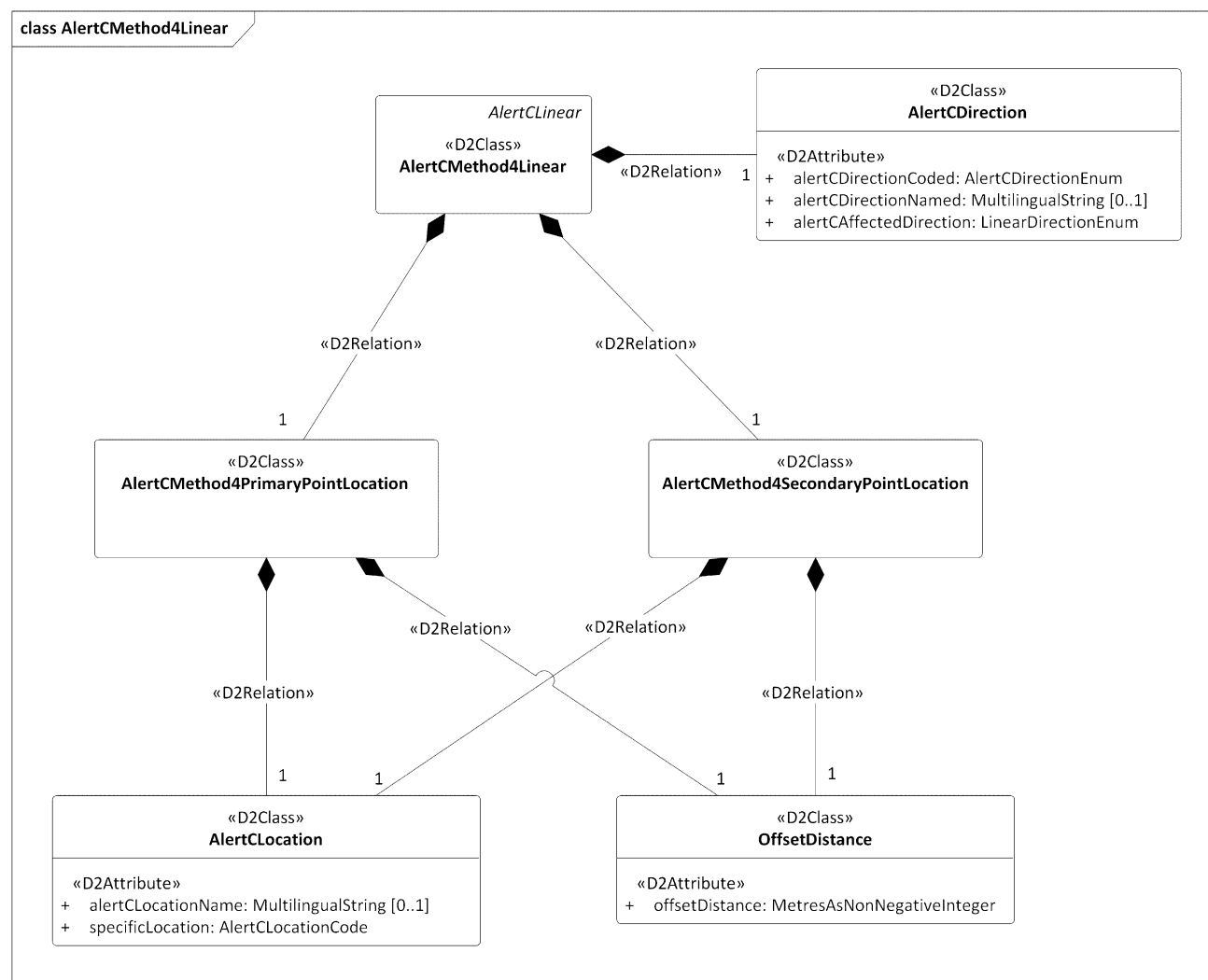


Figure 12 — The “AlertCMethod4Linear” package class model

7.3.3.2 Semantics

An ALERT-C *linear location* reference using method 4 (class “AlertCMethod4Linear”) represents a *linear* section along a road between two points, *primary* and *secondary*, which are pre-defined in an ALERT-C location table and distances. The distance is defined as being the non-negative distance in metres between the ALERT-C point and the actual referenced point (class “OffsetDistance”). Direction is from the *secondary* point (class “AlertCMethod2SecondaryPointLocation”) to the *primary* point (class “AlertCMethod2PrimaryPointLocation”), i.e. the *secondary* point is first met before the *primary* point when the road section is travelled in the *location* direction.

It shall have an associated direction of traffic flow representing the direction of traffic flow along the road to which the information relates (class “AlertCDirection”).

The ALERT-C *linear location* reference is given an ALERT-C direction using a set of predefined coded values. The attribute “alertCDirectionCoded” is used to define which offset type (i.e. negative or positive) is used to navigate in the ALERT-C location table. The attribute “alertCAffectedDirection” specifies the driving direction(s) affected by the traffic object. In case of a ring road, the “alertCDirectionCoded” attribute is used to remove the ambiguity how to reach the *primary* point from the *secondary* point. A name may also be added to complete the direction definition.

7.3.4 The package “AlertCLinearByCode”

7.3.4.1 The class model

The package “AlertCLinearByCode” supplies classes and attributes to the definition of a *linear location* using a pre-defined ALERT-C *linear location*. It is pictured including the relationships between the classes in Figure 13.

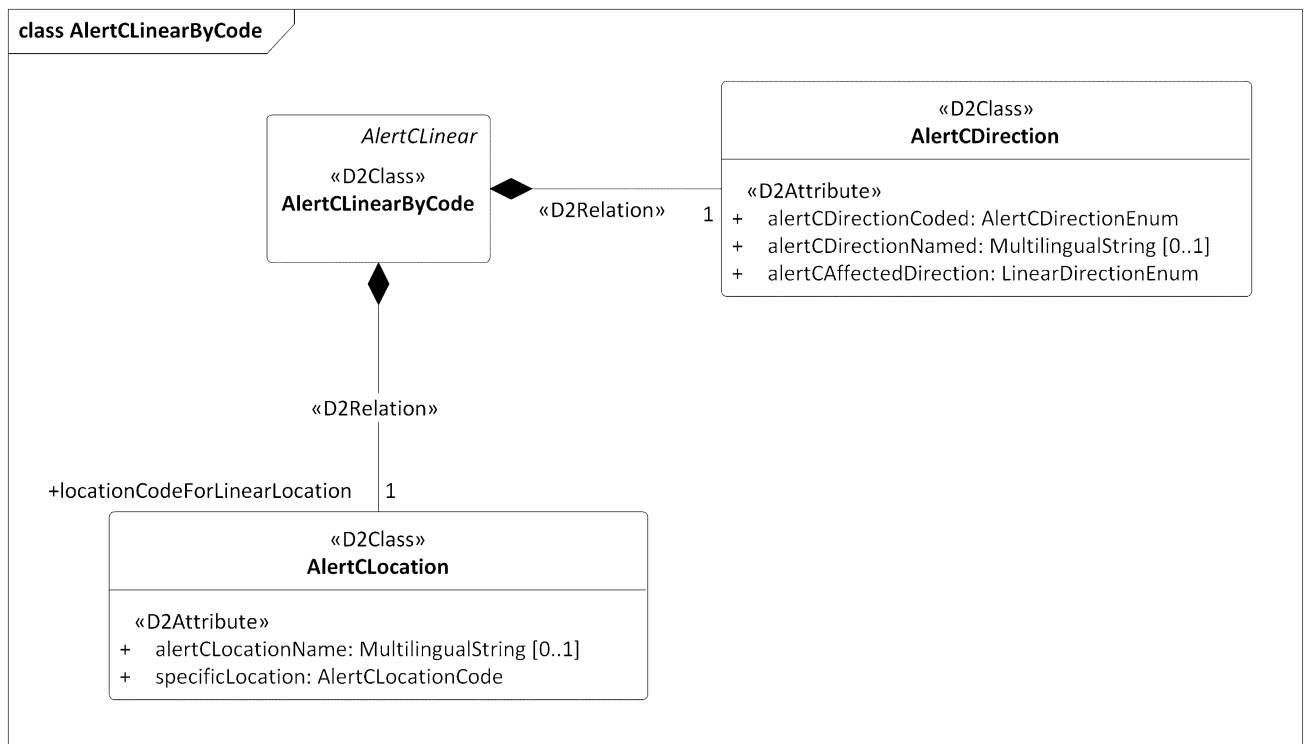


Figure 13 — The “AlertCLinearByCode” package class model

7.3.4.2 Semantics

An ALERT-C linear location reference by code presents a linear section along a road defined by an ALERT-C code i.e. a tabular reference of *linear location* in an ALERT-C location table (class “AlertCLinearByCode”).

It shall have an associated direction of traffic flow representing the direction of traffic flow along the road to which the information relates (class “AlertCDirection”).

The ALERT-C linear location reference is given an ALERT-C direction using a set of predefined coded values. The attribute “alertCDirectionCoded” is used to define which offset type (i.e. negative or positive) is used to navigate in the ALERT-C location table. The attribute “alertCAffectedDirection” specifies the driving direction(s) affected by the traffic object. A name may also be added to complete the direction definition.

7.3.5 The package “TpegLinearLocation”

7.3.5.1 The class model

The package “TpegLinearLocation” supplies classes and attributes to the definition of a *linear location* using methods described in CEN ISO/TS 18234-6 and CEN ISO/TS 24530-2. It is pictured including the relationships between the classes in Figure 14.

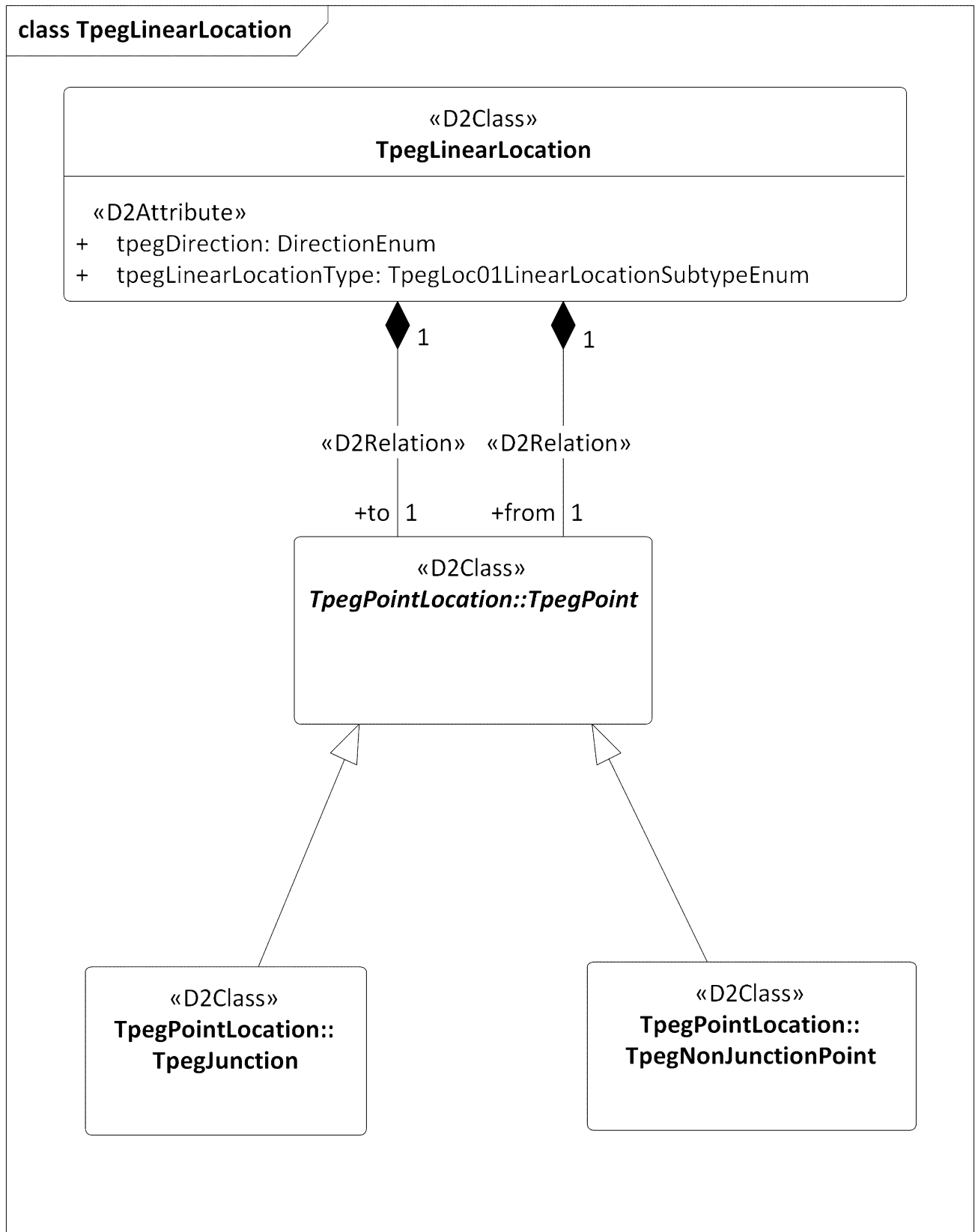


Figure 14 — The “TpegLinearLocation” package class model

7.3.5.2 Semantics

A TPEG *linear location* represents a linear section on the road network defined by TPEG-Loc structures (class “TpegLinearLocation”). It shall have a direction of traffic flow.

This linear section shall be bounded by a “from” point and a “to” point. Both points are defined by a TPEG point location as already defined in 7.2.4.2 (class “TpegPointLocation”).

7.3.6 The package “LinearWithinLinearElement”

7.3.6.1 The class model

The package “LinearWithinLinearElement” supplies classes and attributes to the definition of a *linear location* using different *linear referencing* methods (LRM) as described in EN ISO 19148. It is pictured including the relationships between the classes in Figure 15.

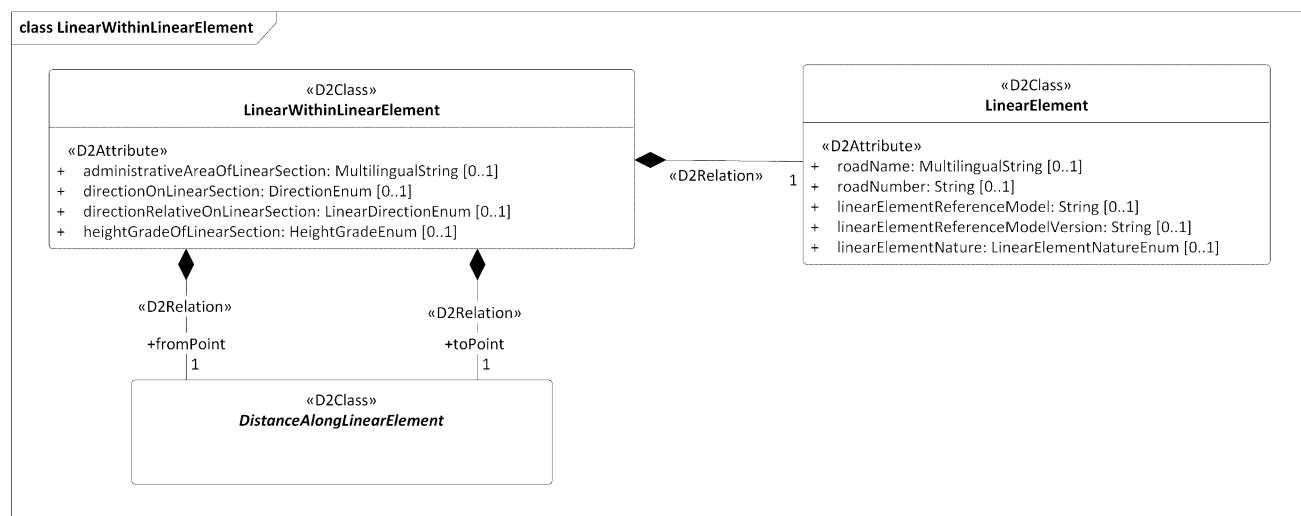


Figure 15 — The “LinearWithinLinearElement” package class model

7.3.6.2 Semantics

A *linear location* defined by a *linear reference* represents a linear section on a linear element, part of the road network. It shall be defined by two points belonging to the same road/street. In addition to the *linear location* definition itself (class “LinearWithinLinearElement”), which contains complementary elements like geographic direction, information whether the point is at-grade or below/above ground level, it shall be realized with two elements:

- The underlying linear element (class “LinearElement”),
- Two distance expressions between a given point on this linear element and respectively the starting point named “from point” and the ending point named “to point”, framing the linear section (abstract class “DistanceAlongLinearElement”).

These elements are defined according to the rules in 7.2.5.2.

7.3.7 The package “OpenlrLinear”

7.3.7.1 The class model

The package “OpenlrLinear” supplies classes and attributes to the definition of a *linear location* using the method detailed in ISO/PRF TS 21219-22. It is pictured including the relationships between the classes in Figure 16.

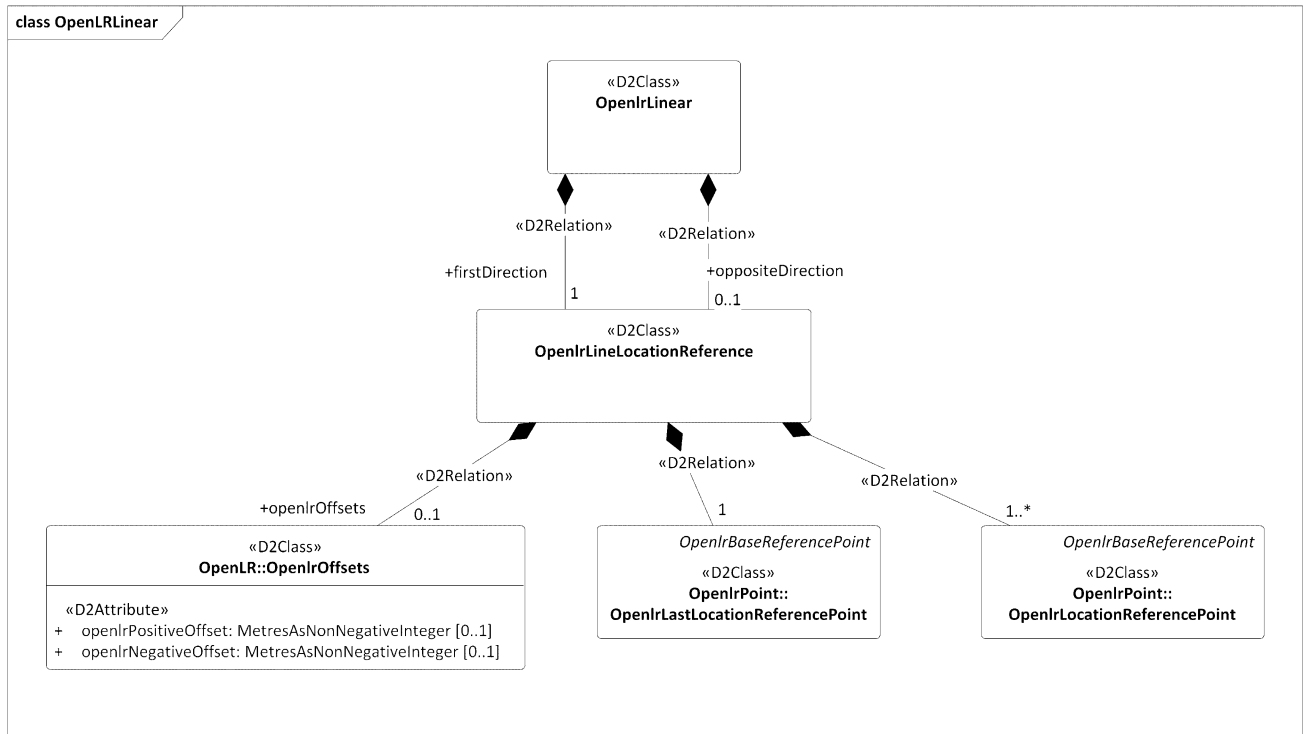


Figure 16 — The “OpenlrLinear” package class model

7.3.7.2 Semantics

An OpenLR™ *linear location* reference (class “OpenlrLinear”) can represent up to two linear sections of a road, corresponding respectively to the aligned direction (“firstDirection” relationship role) and to the opposite direction (“oppositeDirection” relationship role).

Each linear section is defined (using the “OpenlrLineLocationReference” class) by a sequence of instances of the “OpenlrLocationReferencePoint” class and finishing by one instance of the “OpenlrLastLocationReferencePoint” class. These classes and their related ones are defined in 7.2.7.2.

Each instance of the “OpenlrLineLocationReference” may be accompanied by a positive offset, respectively a negative offset, along the line of the location using the “OpenlrOffsets” class, when the start point, respectively the end point, of the location does not coincide with the node starting, respectively ending, the location reference path.

7.3.8 The package “GmlLineString”

7.3.8.1 The class model

The package “GmlLineString” only includes one class with its attributes for the definition of a *linear location* which specializes a *location* of a traffic object. It is pictured in Figure 17.

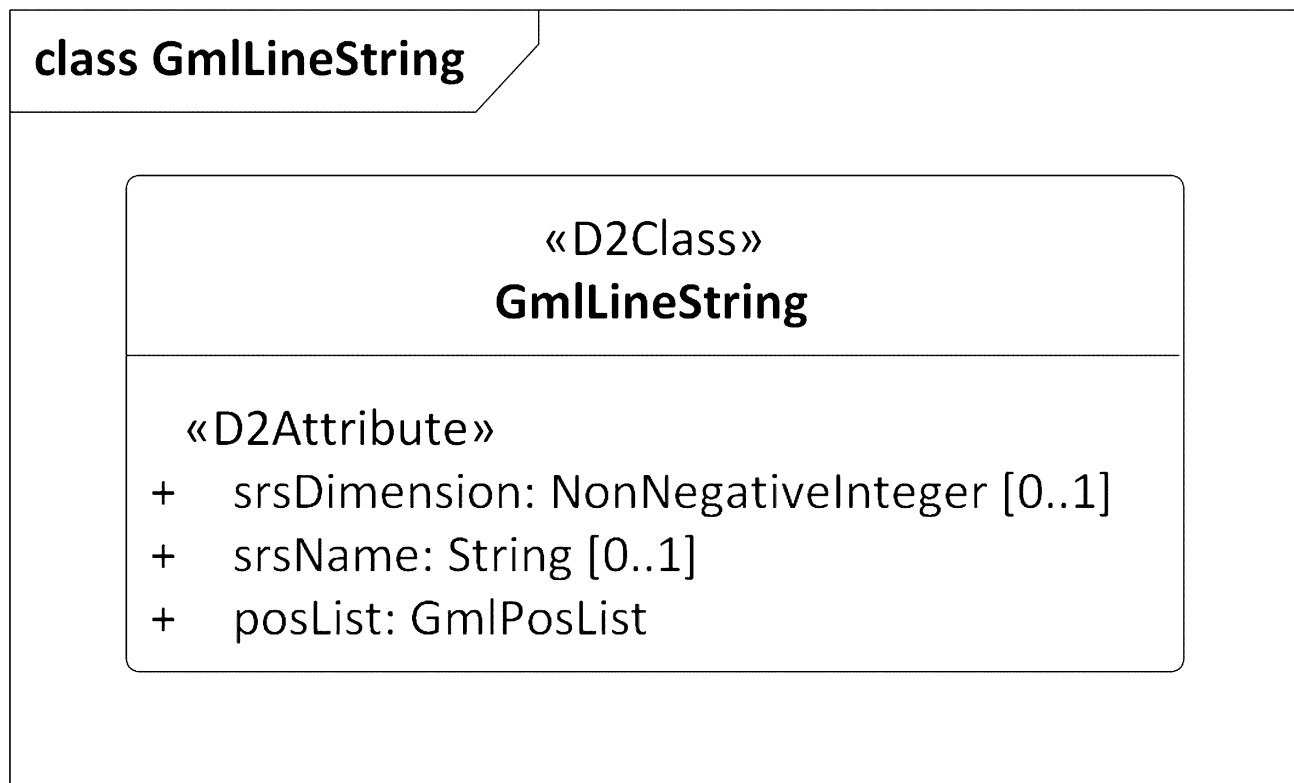


Figure 17 — The “GmlLineString” package class model

7.3.8.2 Semantics

The corresponding class instantiates a GML *line string* and has three attributes:

- the “posList” attribute which contains the ordered list of the two- or three-dimensional point coordinates according to EN ISO 19136 (corresponding GML attribute: gml:posList);
- the “srsName” attribute which specifies the Coordinate Reference System (CRS) used to interpret the corresponding coordinates in this GmlLineString. This attribute is defined according to the same standard. Unlike GML where it is mandatory, when this attribute is not filled in the corresponding CRS is “ETRS89-LatLonh”;
- The “srsDimension” which provides the number of coordinates for each point belonging to the LineString. This value is either 2 or 3. If it is not provided, the default value is “2”.

NOTE The order of coordinates is defined according to the CRS chosen [3]. Generally, the sequence is “latitude” then “longitude”.

The order of the points forming the *line string* provides the direction of the geographic feature.

EXAMPLE In case the postList attribute contains a set of six coordinate values, it will represent a line defined by two points when the dimension is “3”. In the other cases, the line will be defined by three points in the same plan.

7.4 Area locations

7.4.1 The package “AreaLocation”

7.4.1.1 The class model

The package “AreaLocation” supplies classes and attributes to the definition of an *area*-typed *location* which specializes a *location* of a traffic object. It is pictured including the relationships between the classes in Figure 18.

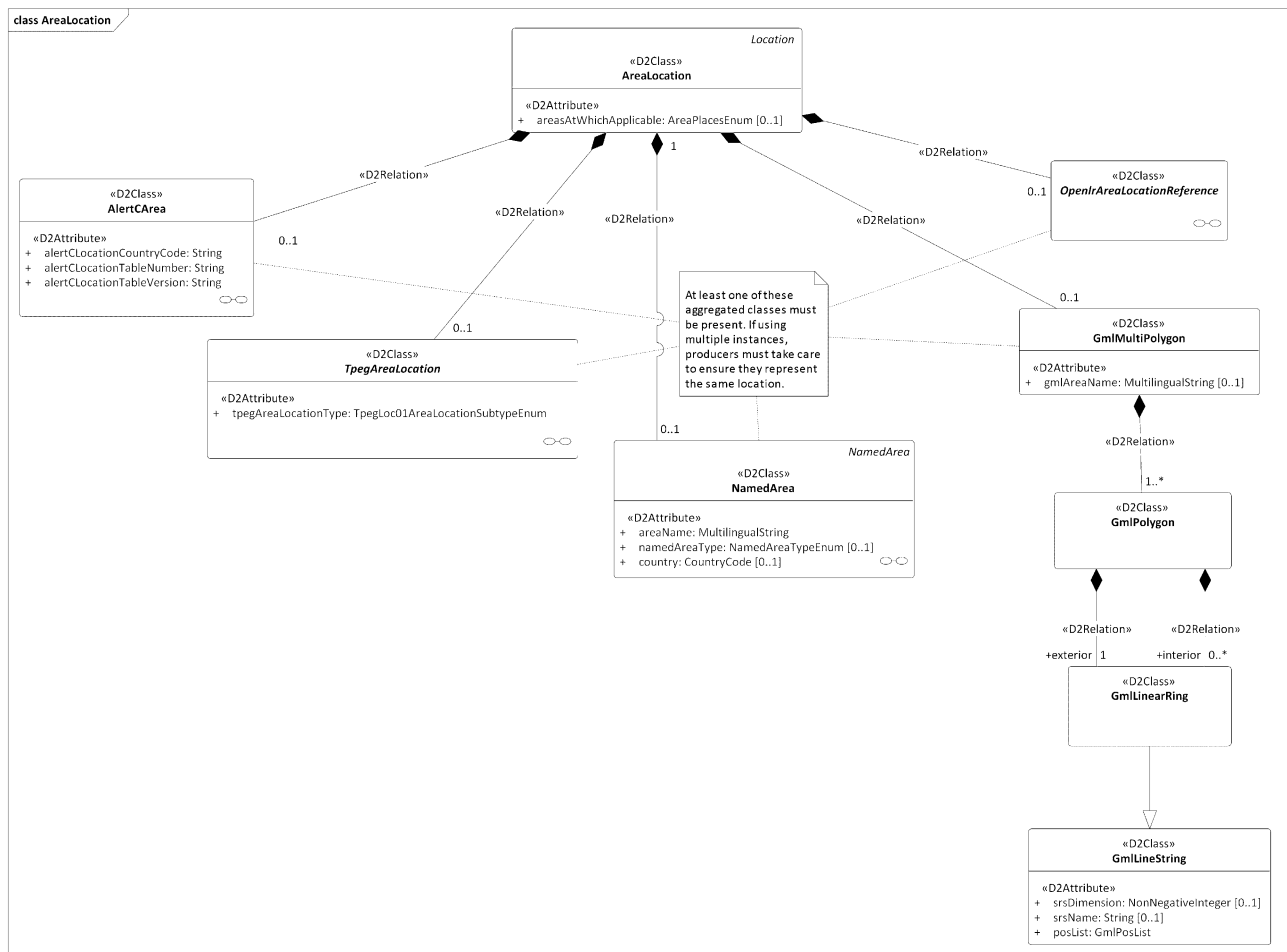


Figure 18 — The “AreaLocation” package class model

7.4.1.2 Semantics

An *area* (class “AreaLocation”) can be either a geographic or a geometric two-dimensioned feature. It may be qualified by height information to provide additional geospatial discrimination (e.g. for snow in an *area* but only above a certain height). It shall be referenced using one of the following five methods without being exclusive:

- the Alert-C *location* referencing method (class “AlertCArea”);
- the TPEG-Loc *location* referencing method (class “TpegAreaLocation”);
- the OpenLR™ *location* referencing method (class “OpenlrArea”);

- as a named area (class “NamedArea”);
- as an area defined as a multipolygon (class “GmlMultiPolygon”).

These first four classes are respectively defined in 7.4.2, 7.4.3, 7.4.4 and 7.4.5.

The fifth method complies with EN ISO 19136. A MultiPolygon is a case of GML_MultiSurface where all the surfaces belonging to the set are *polygons* (class “GmlPolygon”). When this area is defined by several *polygons* (and not only one), each of them may be associated with a name (attribute “sectionName”) to distinguish them.

Each *polygon* is defined by an exterior linear ring and zero to several interior linear rings that define interior patches. A linear ring (class “GmlLinearRing” equivalent to GM_LinearRing) is a specific, not self-intersecting closed curve derived from a *line string*, i.e. where the last *tuple* is identical to the first one. Such linear ring is composed of at least four positions. This linear ring is not self-intersecting to avoid creating fragmented (non-compact) areas since several exteriors can be attached to an instance of the “GmlMultiPolygon” class.

7.4.2 The package “AlertCArea”

7.4.2.1 The class model

The package “AlertCArea” supplies classes and attributes to the definition of an *area*-typed *location* using a pre-defined ALERT-C *area location*. It is pictured including the relationships between the classes in Figure 19.