SLOVENSKI STANDARD
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Inteligentni transportni sistemi - Prostorski podatki ITS - Izmenjava podatkov o spremembah atributov cest

Intelligent transport systems - ITS spatial data - Data exchange on changes in road attributes

Intelligente Verkehrssysteme - Räumliche ITS-Daten - Datenaustausch zu Änderungen von Straßenattributen

Systèmes de transport intelligents - Données spatiales STI - Échange de données sur les modifications d'attributs routiers

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Intelligent transport systems - ITS spatial data - Data exchange on changes in road attributes

Systèmes de transport intelligents - Données spatiales STI - Échange de données sur les modifications d'attributs routiers

Intelligente Verkehrssysteme - Räumliche ITS-Daten - Datenaustausch zu Änderungen von Straßenattributen

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European foreword

This document (CEN/TS 17268:2018) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Introduction

ITS digital maps (digital maps for ITS applications) were initially developed for in-vehicle navigation systems. Over time, these maps evolved, and their use extended beyond mere navigation, as a range of other in-vehicle driving support systems were developed, many of which need ITS digital maps as an important component for processing, interpreting and relating sensor data. This evolution from navigation via ADAS (advanced driver assistance systems) and then C-ITS (cooperative ITS systems) to automated driving generates increasing requirements for the digital map, in terms of content specification, detail, accuracy and timeliness. The latter characteristic signifies whether the map data are up to date with respect to changes in the real world.

ITS digital maps represent the physical road network infrastructure and its attributes, as well as other relevant geographic information. The related data has a more or less permanent character, and is sometimes referred to as static road data; road data that do not often change [9]. Besides for the abovementioned applications, accurate and up to date digital maps have also high significance for the provision of real-time road status and traffic information. This concerns dynamic road-related data, with a highly volatile and temporary character. Typically data that will not be included in a digital map, but generally need digital map data for processing, representation and display.

Although the road infrastructure has a rather permanent character, changes of the road network and related attributes do actually occur at a significant scale. There is a need for timely and comprehensive propagation of information on such changes to digital maps used in ITS applications. Providers of such maps use a multitude of data sources to maintain their map databases, in order to keep these accurate and up to date. These sources include visual inspection (by driving the roads), and the use of vehicle probe data (big data that need processing, interpretation and verification).

The specification in this document aims to enable another mechanism for provision of static road data, with a focus on changes, directly from the source of the changes: the public road authorities and/or (public/private) road operators, who build and maintain the roads, and decide on and implement the day-to-day changes that are relevant for inclusion in ITS digital maps. If road authorities and road operators maintain a digital road database of their network, and have good procedures for keeping such database fully up to date in a timely manner with respect to these changes, this would constitute a highly efficient and potentially timely source for information on such changes for ITS map providers, but also for other users of such data.

Based on good procedures, intense cooperation between the two sides of this data chain, and experience gained over time, the data flow will achieve a high level of reliability, with known and guaranteed quality. The data constitutes well-defined discrete data elements that do not need any big-data type of processing, permitting swift implementation for any potential users. Dependent on the timeliness of the processes deployed at, respectively, road authorities, road operators, ITS map providers and map-update-provision services, the TN-ITS concept permits future transfer of information on road network changes to in-vehicle systems with minimal delays. This document defines the TN-ITS specification.

The exchanged data elements are termed road features in this document. Each road feature is required to have a location reference, identifying its location in the road network. The specification within this document is flexible and supports the introduction of new data types by permitting the use of external code lists.

The “Commission Delegated Regulation (EU) 2015/962 of 18 December 2014 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services” [9] sets out the requirements, for road authorities, road operators and service providers, for the accessibility, exchange, re-use and provision of updates of static road data, road status data and traffic data. Road authorities and road operators provide the static road data they collect and update in a standardized format, if available, or in any other machine-readable format, on a non-discriminatory basis, and digital map providers collaborate with the data providers to ensure that any inaccuracies related to static road data are signalled without delay to the road authorities

and road operators from which the data originates. For dynamic road status data and traffic data the Delegated Regulation in Articles 5 and 6 mandates the use of DATEX II (CEN/TS 16157 series and subsequently upgraded versions) format or any machine-readable format fully compatible and interoperable with DATEX II. The Delegated Regulation provides a list of types of static road data to be addressed. This document takes full account of the part of the Regulation concerning static road data, and supports and facilitates road authorities, road operators and digital map providers to implement and fulfil the requirements of the Regulation with respect to the provision and use of such data.

The document's specification is well aligned with Directive 2007/2/EU establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Under this directive, public authorities provide road network geospatial data sets in an INSPIRE-compliant way. Linear location referencing enabled by this document's specification establishes a direct (and INSPIRE-compliant) connection between the exchanged road features and the originating geospatial data set of the public authority. This will provide users with easy access to the specific location of the road feature in the originating database for inspection, in case decoding of the dynamic location reference, used for automated processing of the data, fails.

The idea for the TN-ITS concept for data exchange developed during the EU-funded projects PReVENT/MAPS&ADAS (2004/2007) and SpeedAlert (2004/2005), and was further elaborated and tested in the EU-funded ROSATTE project (Road Safety Attributes Exchange Infrastructure in Europe; 2008-2010), in which the basis for this specification was laid. This work led in 2013 to the foundation of the TN-ITS Platform for deployment of the concept. In the past years, implementation in several European countries took place, and a further roll-out in Europe with support from the EU CEF Programme (Connecting Europe Facility) is ongoing.

The European Committee for Standardization (CEN) draws attention to the fact that it is claimed that compliance with some stipulations of this document may involve the use of one or more patents when using AGORA-C location referencing, standardized in ISO 17572-3, and/or OpenLR location referencing, both described in 6.4 and Annex B. EN ISO 19148 for linear referencing has not identified any patents.

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

1 Scope

This document defines the content specification for the exchange of road-related spatial data, and especially updates thereof. Based on the content specification, this document defines also a physical exchange format (structure and encoding) for the actual data exchange. In addition, it defines web services that are needed to make the coded data on updates available. Exchange of dynamic information is not in the scope of this document.

Although the focus of this document is on providing information on updates, the technology described in this document in principle also enables the exchange of full data sets, either concerning the whole road network in a coverage area, including all geometry and all attributes, or a subset, concerning for instance all instances of one or more specific attributes.

NOTE This document does not support the provision of updates concerning geometry. The provision of geometry associated with attribution change is supported, in the context of providing the location of attribute change.

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.

EN ISO 14823, *Intelligent transport systems - Graphic data dictionary (ISO 14823)*

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

EN ISO 19107, *Geographic information - Spatial schema (ISO 19107)*

EN ISO 19108, *Geographic information - Temporal schema (ISO 19108)*

EN ISO 19109, *Geographic information - Rules for application schema (ISO 19109)*

EN ISO 19111, *Geographic information - Spatial referencing by coordinates (ISO 19111)*

EN ISO 19115-1:2014, *Geographic information – Metadata – Part 1: Fundamentals (ISO 19115-1:2014)*

EN ISO 19115-2, *Geographic information – Metadata – Part 2: Extensions for imagery and gridded data (ISO 19115-2)*

EN ISO 19136, *Geographic information - Geography Markup Language (GML) (ISO 19136)*

EN ISO 19148, *Geographic information - Linear referencing (ISO 19148)*

ISO 17572-3, *Intelligent transport systems (ITS) - Location referencing for geographic databases - Part 3: Dynamic location references (dynamic profile)*

ISO 19103, *Geographic information - Conceptual schema language*

ISO/TS 19115-3, *Geographic information – Metadata – Part 3: XML schema implementation for fundamental concepts*

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:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
location reference
code which provides a reference to a simple or compound geographic object

Note 1 to entry: With a single Location Referencing Method, one reference shall define unambiguously and exactly one location in the location referencing system. The reference is the set of data which is passed between different implementations of a location referencing system to identify the location.

Note 2 to entry: A location reference code is created from information in the road database that represents the road network, either based on a location referencing system that is reflected in the road database (including linear referencing systems), or on coordinates and attributes extracted from the road database. A location reference may address a point location, a linear location or an area location.

3.2
digital map database
structured set of digital and alphanumeric data portraying geographic locations and relationships of spatial features

Note 1 to entry: Typically, such structures represent, but are not limited to, the digital form of hard copy maps. For example, drawings can be imported into a Geographic Information System (GIS) and considered as a form of digital map.

[SOURCE: ISO 17572-1:2013]

3.3
road database
structured set of digital and alphanumeric data representing characteristics of a road network, possibly including spatial representation

3.4
road feature
distinctive road-related attribute or object including its location that defines a real-world phenonemon

Note 1 to entry: The location may be a point, a linear location or an area location, and is expressed by a location reference.

3.5
road sign
physical traffic control device intended to communicate specific information to road users through a word, symbol, and/or arrow legend

Note 1 to entry: Road signs do not include highway traffic signals, pavement markings, delineators, or channelization devices.

[SOURCE: CEN ISO/TS 19091:2017]

Note 2 to entry: Road signs are by their nature associated with a point location.

Note 3 to entry: Road signs may be permanent or temporary fixed plates (with or without temporal limitations), signs displayed on variable message signs or changeable boards, or other means of displaying signs.

3.6
traffic regulation
rule or directive, made and maintained by an authority, related to the road network and its use

Note 1 to entry: A traffic regulation may cover a point along a road, a linear stretch of a road or an area (which can be a complete national territory (e.g. "generic speed limits")), and may be expressed by one or more road signs, road markings or traffic signals. Not all traffic regulations are expressed by road signs.

4 Symbols and abbreviated terms

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
GDF	Geographic Data Files
GML	Geographic Markup Language
ID	Identifier
INSPIRE	Infrastructure for Spatial Information in Europe
ITS	Intelligent Transport Systems
OCL	Object Constraint Language
OGC	Open Geospatial Consortium
REST	Representational state transfer
ROSATTE	ROad Safety ATTributes in Europe
TN-ITS	Transport Network – Intelligent Transport Systems
UML	Unified Modelling Language
UTC	Coordinated Universal Time
UUID	Universally Unique Identifier
WADL	Web Application Description Language
XML	Extensible Markup Language
XSD	XML Schema Definition

5 Conformance

Conformance is achieved by ensuring conformance to:

1. the requirements of the data content specification (Clause 6);
2. the requirements of structure and encoding of the physical exchange format (Clause 7);
3. The requirements of the service specification (Clause 8).

6 Data content specification

6.1 Introduction

To comply with the requirements of the INSPIRE Directive and its technical specifications and the ISO 19100 series of standards, the conceptual data content specification has been specified in conformance with EN ISO 19109 – Rules for application schema. The data content specification specifies the various classes of information that are being used within TN-ITS without mandating a particular technology for implementation. The data content specification uses UML constructs such as packages, classes, attributes, associations and OCL constraints, and assumes that the reader is familiar in that domain.

The data content specification is organized in packages where each package corresponds to a separate subset of the TN-ITS domain. Each package contains a number of classes with attributes and associations.

The TN-ITS model defines the following basic concepts:

- Data sets consisting of road features and metadata describing the content of the data set.

  These data sets are foreseen as being exchanged from road authorities/road operators to information users (map providers). For the primary use-case, this type of data set actually contains incremental updates for road features that occurred in a TN-ITS data store since the last time data exchange took place. These updates make use of a unique identifier (ID). It shall be the responsibility of the information user (map provider) to remember when the last successful data set was created. The difference between a data set containing incremental updates and a data set containing a complete snapshot from a TN-ITS data store is explained in 6.8.

- Another type of data set consisting of feedback information from information users (including map providers) to information providers (e.g. road authorities/road operators).

- Road features which describe the contents of traffic regulations, safety-related features or other road-related features of interest to road users. A road feature is primarily described by:

  1) its type (for example: speed limit, restriction for vehicles, overtaking ban, etc.);

  2) property values (for example: speed limit value, maximum weight, etc.);

  3) conditions for when the road feature is applicable (which may include: time period, vehicle type, weather conditions, etc.);

  4) location;

  5) update information; for data sets containing incremental updates, all road features shall contain information on the applicable update primitive.

6.2 Package overview

Figure 1 shows the different packages used within TN-ITS and their interdependencies. The figure shows that a number of external definitions are being used:

a) Regarding metadata, the INSPIRE Implementing Rules are used, and the UML definitions are imported from the EN ISO 19115 series. The exact definition in UML and text of the used metadata elements are not repeated in this document.

b) Definitions from ISO 19103, EN ISO 19108, and EN ISO 14825 are being used whenever applicable.

All enumerations and codelists used in this specification are listed in the normative Annex A.

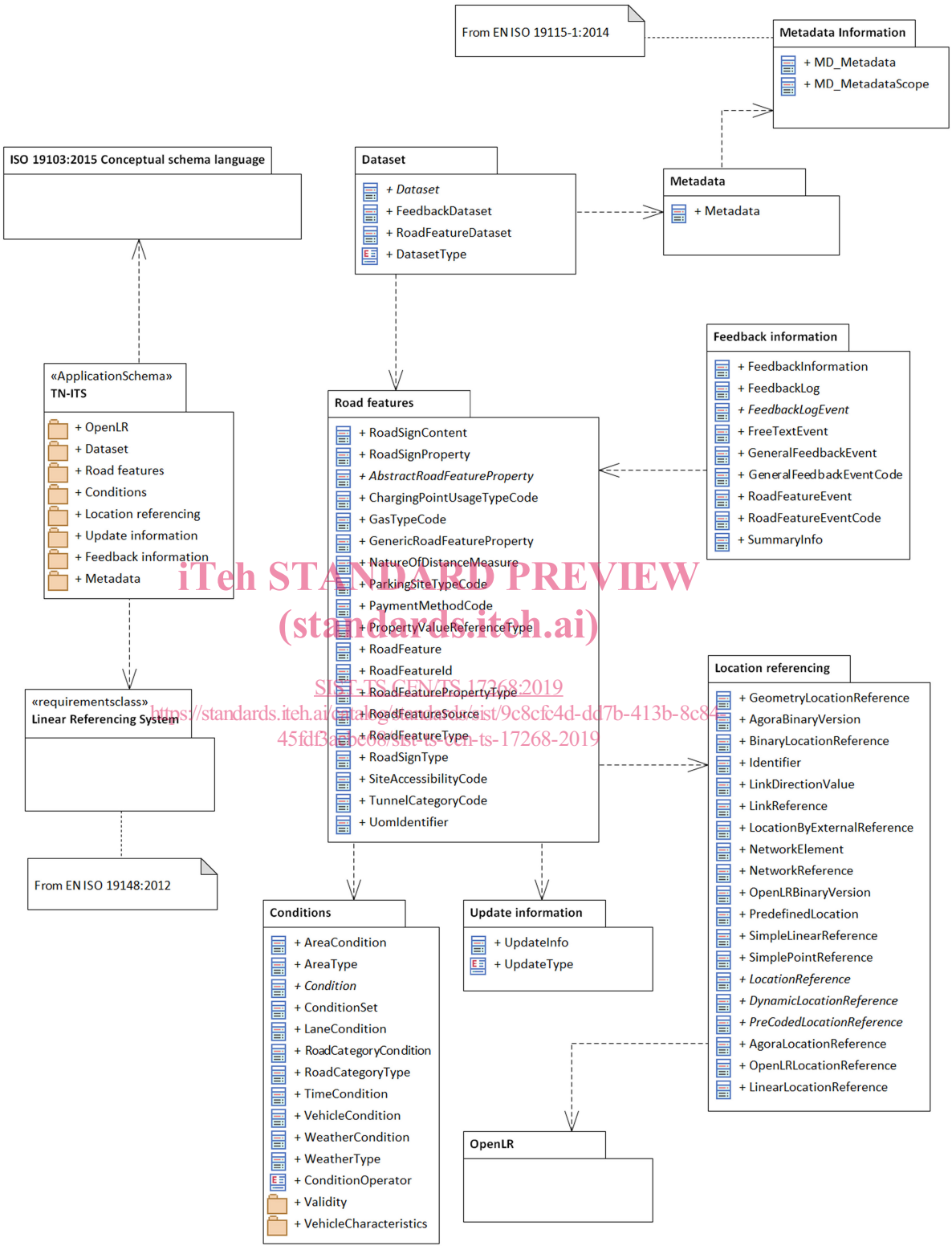

Figure 1 — Package overview

6.3 Package Road features

6.3.1 Overview

This package defines the various road features that may be used within TN-ITS.

NOTE 1 The package uses a generic and flexible modelling approach which means that the set of specific road feature types and road feature type properties can be extended by extending the appropriate codelists. This means that all road feature types are handled by the same small set of UML classes.

NOTE 2 An alternative approach would have been to model each type of road feature as a separate specific UML class. The main reasons for proposing the generic approach are the following:

1. simple model with few classes;
2. easily extendable model;
3. simple to define the update service protocol.

Figure 2 defines the classes and attributes of the Road features package.

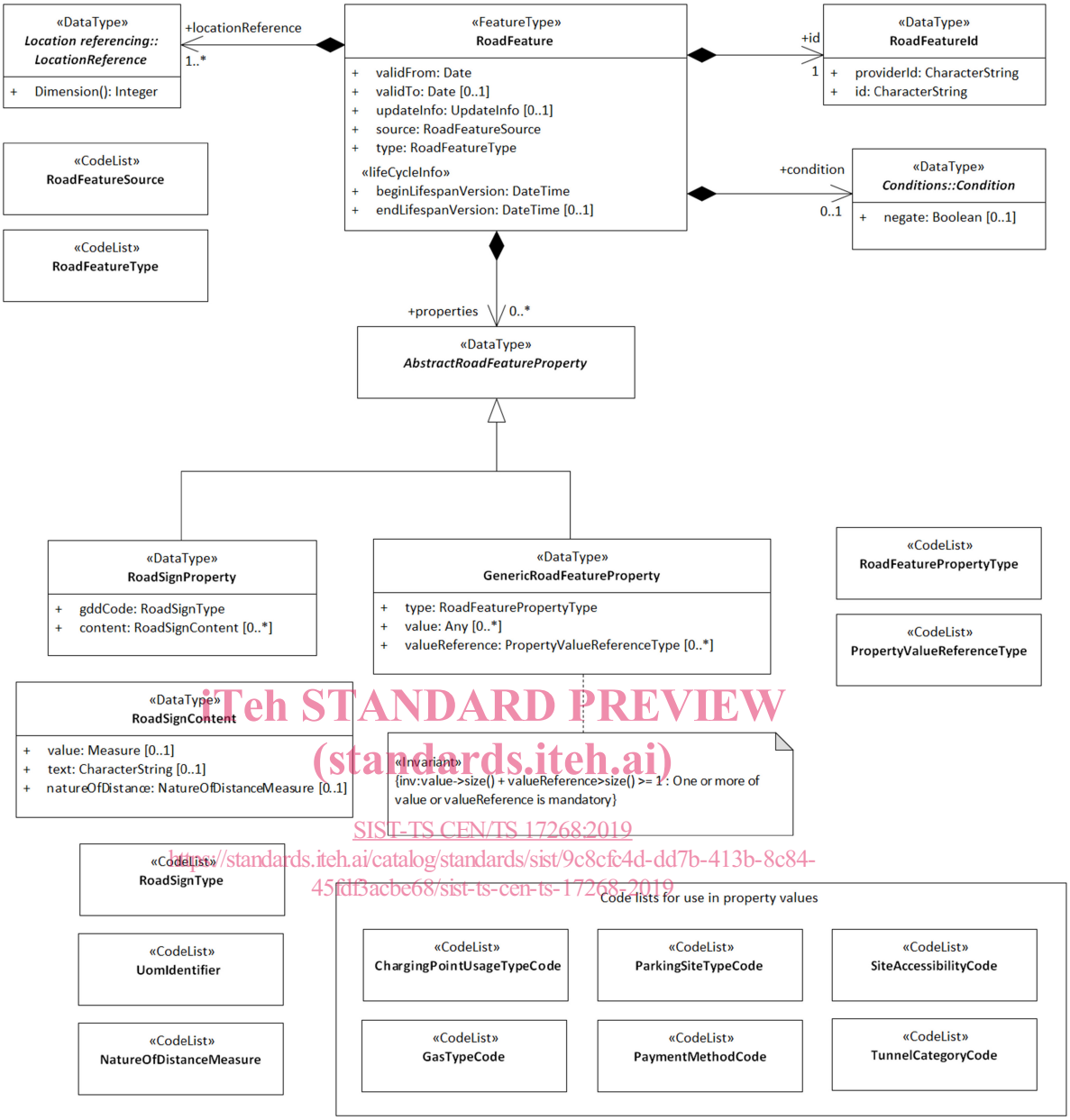

Figure 2 — Road Feature attributes