INTERNATIONAL STANDARD

ISO 19148

First edition
2012-02-15

Geographic information — Linear referencing

Information géographique — Référencement linéaire

Reference number
ISO 19148:2012(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 19148 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

This International Standard is a description of the data and operations required to support linear referencing. This includes Linear Referencing Systems, linearly located events and linear segments.

Linear Referencing Systems enable the specification of positions along linear objects. The approach is based upon the Generalized Model for Linear Referencing[3] first standardized within ISO 19133:2005, 6.6. This International Standard extends that which was included in ISO 19133, both in functionality and explanation.

ISO 19109 supports features representing discrete objects with attributes having values which apply to the entire feature. ISO 19123 allows the attribute value to vary, depending upon the location within a feature, but does not support the assignment of attribute values to a single point or length along a linear feature. Linearly located events provide the mechanism for specifying attribution of linear objects when the attribute value varies along the length of a linear feature. A Linear Referencing System is used to specify where along the linear object each attribute value applies. The same mechanism can be used to specify where along a linear object another object is located, such as guardrail or a traffic accident.

It is common practice to segment a linear object having linearly located events, based upon one or more of its attributes. The resultant linear segments are attributed with just the attributes used in the segmentation process, insuring that the linear segments are homogeneous in value for these segmenting attributes.

This International Standard differs from ISO 19133:2005, 6.6 in the following areas.

a) All occurrences of Linear Reference Method and Linear Reference System have been changed to Linear Referencing Method and Linear Referencing System, respectively.

b) LR_Element has been renamed LR_LinearElement and further defined as being a feature or geometry or topology. These shall support the newly introduced interface ILinearElement, meaning that it is possible to measure (linearly) along them.

c) The newly introduced ILinearElement interface includes operations for returning the default Linear Referencing Method of the linear element and any of its length or weight attribute values. It also includes operations for translating between Linear Referencing Methods and/or linear elements.

d) The types of Linear Referencing Methods have been formalized as a CodeList. Names of common Linear Referencing Methods have been added as an informative annex.

e) An additional attribute, constraint[0..*], has been added to Linear Referencing Method to specify the constraints imposed by the method, such as “only allows reference marker referents”. This is an alternative to subtyping the methods that would force a too-structured approach, inconsistent with the Generalized Model, and would be indeterminate due to the wide variety of Linear Referencing Methods currently in use.

f) The Linear Referencing Method “project” operation has been renamed “lrPosition” and moved to the ISpatial interface and a second, opposite, operation “point” has been added. Only LR_Curves realize this interface since their spatial representation is requisite for the two operations, along with the ILinearElement interface.

g) The LR_PositionExpression measure attribute has been extracted out into a Distance Expression along with the optional referent and offset roles consistent with the original theoretical model. This allows for specifying only an LR_DistanceExpression when the LR_LinearElement and LR_LinearReferencingMethod are already known.

h) Reference Marker has been generalized to LR_Referent to enable support for other referent types such as intersections, boundaries and landmarks. This type has been formalized as a CodeList.

i) A second, optional (towards) Referent has been added in a new (optional) package, Linear Referencing Towards Referent (LRTR), for those Linear Referencing Methods which allow this to disambiguate measurement direction.

j) Lateral Offsets have been moved to a new (optional) package, Linear Referencing Offset (LRO). Horizontal, vertical, and combined horizontal and vertical offsets are now supported. Offset referent has been generalized to allow for feature instances as well as character strings.

k) Vector Offsets have been adopted from ISO 19141. They exist in a new (optional) package, Linear Referencing Offset Vector (LROV). An optional offset vector Coordinate Reference System (CRS) can be provided if it is different from the CRS of the linear element.

l) The theoretical model on which the original standard was built is explained in Annex B.

m) More descriptive text is added throughout this International Standard to explain the concepts being presented.

n) Minor changes to some class, attribute and role names have been made.

o) A new (optional) package, Linearly Located Event (LE) has been added which uses linearly referenced positions to specify where along a linear feature a particular attribute value or other feature instance applies.

p) A new (optional) package, Linear Segmentation (LS) has been added to support the generation of homogeneous attributed linear segments from linear features with length-varying attribution.

q) Absolute Linear Referencing Method with non-zero linear element start is now accommodated.

r) lateralOffsetReferentType and verticalOffsetReferentType have been changed from CodeLists to Character Strings.

Geographic information — Linear referencing

1 Scope

This International Standard specifies a conceptual schema for locations relative to a one-dimensional object as measurement along (and optionally offset from) that object. It defines a description of the data and operations required to use and support linear referencing.

This International Standard is applicable to transportation, utilities, location-based services and other applications which define locations relative to linear objects.

2 Conformance

2.1 Conformance overview

Clause 6 of this International Standard uses the Unified Modelling Language (UML) to present conceptual schemas for describing the constructs required for Linear Referencing. These schemas define conceptual classes that shall be used in application schemas, profiles and implementation specifications. This International Standard concerns only externally visible interfaces and places no restriction on the underlying implementations other than what is required to satisfy the interface specifications in the actual situation, such as

— interfaces to software services using techniques such as SOAP;

— interfaces to databases using techniques such as SQL;

— data interchange using encoding as defined in ISO 19118.

Few applications require the full range of capabilities described by this conceptual schema. Clause 6, therefore, defines a set of conformance classes that support applications whose requirements range from the minimum necessary to define data structures to full object implementation. This flexibility is controlled by a set of UML types that can be implemented in a variety of manners. Implementations that define full object functionality shall implement all operations defined by the types of the chosen conformance class, as is common for UML designed object implementations. It is not necessary for implementations that choose to depend on external "free functions" for some or all operations, or forgo them altogether, to support all operations, but they shall always support a data type sufficient to record the state of each of the chosen UML types as defined by its member variables. It is acceptable to use common names for concepts that are the same but have technically different implementations. The UML model in this International Standard defines abstract types, application schemas define conceptual classes, various software systems define implementation classes or data structures, and the XML from the encoding standard (ISO 19118) defines entity tags. All of these reference the same information content. There is no difficulty in allowing the use of the same name to represent the same information content even though at a deeper level there are significant technical differences in the digital entities being implemented. This "allows" types defined in the UML model to be used directly in application schemas.

2.2 Conformance classes

2.2.1 General

Conformance to this International Standard shall consist of either data type conformance or both data type and operation conformance.

2.2.2 Data type conformance

Data type conformance includes the usage of data types in application schemas or profiles that instantiate types in this International Standard. In this context, "instantiate" means that there is a correspondence between the types in the appropriate part of this International Standard, and the data types of the application schema or profile in such a way that each standard type can be considered as a supertype of the application schema data type. This means that an application schema or profile data type corresponding to a standard type contains sufficient data to recreate that standard type's information content.

Table 1 assigns conformance tests to each of the packages in Clause 6. Each row in the table represents one conformance class. A specification claiming data type conformance to a package in the first column of the table shall satisfy the requirements specified by the tests given in the remaining columns to the right.

Table 1 — Data type conformance tests

Package	Conformance test					
	A.1.1	**A.1.2**	**A.1.3**	**A.1.4**	**A.1.5**	**A.1.6**
Linear Referencing System	X	—	—	—	—	—
Linear Referencing Towards Referent	X	X	—	—	—	—
Linear Referencing Offset	X	—	X	—	—	—
Linear Referencing Offset Vector	X	—	X	X	—	—
Linearly Located Event	X	—	—	—	X	—
Linear Segmentation	X	—	—	—	X	X

2.2.3 Operation conformance

Operation conformance includes both the consistent use of operation interfaces and data type conformance for the parameters, and return values used by those operations. Operation conformance also includes get and set operations for attributes.

Table 2 assigns conformance tests to each of the packages in Clause 6. Each row in the table represents one conformance class. A specification claiming operation conformance to a package in the first column of the table shall satisfy the requirements specified by the tests given in the remaining columns to the right.

Table 2 — Operation conformance tests

Package	Conformance test					
	A.1.1 **A.2.1**	**A.1.2** **A.2.2**	**A.1.3** **A.2.3**	**A.1.4** **A.2.4**	**A.1.5** **A.2.5**	**A.1.6** **A.2.6**
Linear Referencing System	X	—	—	—	—	—
Linear Referencing Towards Referent	X	X	—	—	—	—
Linear Referencing Offset	X	—	X	—	—	—
Linear Referencing Offset Vector	X	—	X	X	—	—
Linearly Located Event	X	—	—	—	X	—
Linear Segmentation	X	—	—	—	X	X

3 Normative references

The following referenced documents are indispensable for the application 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/TS 19103, *Geographic information — Conceptual schema language*

ISO 19107, *Geographic information — Spatial schema*

ISO 19108, *Geographic information — Temporal schema*

ISO 19111, *Geographic information — Spatial referencing by coordinates*

4 Terms and definitions

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

4.1
attribute event
value of an attribute of a **feature** (4.4) that may apply to only part of the feature

NOTE 1 An attribute event includes the **linearly referenced location** (4.16) where the attribute value applies along the **attributed feature** (4.2).

NOTE 2 An attribute event may be qualified by the **instant** (4.8) in which, or **period** (4.20) during which, the attribute value applied.

4.2
attributed feature
feature (4.4) along which an **attribute event** (4.1) applies

4.3
direct position
position (4.21) described by a single set of coordinates within a coordinate reference system

[ISO 19107:2003, 4.26]

4.4
feature
abstraction of real world phenomena

[ISO 19101:2002, 4.11]

4.5
feature event
information about the occurrence of a **located feature** (4.17) along a **locating feature** (4.18)

NOTE 1 A feature event includes the **linearly referenced location** (4.16) of the located feature along the locating feature.

NOTE 2 A feature event may be qualified by the **instant** (4.8) in which, or **period** (4.20) during which, the feature event occurred.

4.6
geometric primitive
geometric object representing a single, connected, homogeneous element of space

[ISO 19107:2003, 4.48]