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Geographic information — Linear referencing

Information géographique — Référencement linéaire

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Foreword

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 19148:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

— revision of the definition of the term linear element, removing a circular reference with the definition for the term linear referencing;

— introduction of the definition of the term referent;

— revision of the conceptual schema to meet current standards and harmonize with other ISO/TC 211 International Standards;

— refactoring of the core Linear Referencing System package, abstracting implementation classes into a new Application Schema package which is now presented as an example in Annex D;

— introduction of an approach addressing broken-chainage;

— introduction of an enumeration addressing directionality of measurements;

— introduction of an approach addressing Cross-Sectional Positioning (XSP) conventions;

— introduction of an approach addressing Measures with Uneven Distribution;

— refactoring of the Linearly Located Event package dropping the previous assumption that the Linear Element was always of a Feature type;

— introduction of simplifications of the conceptual schema;

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— additional example illustrating Measures with Uneven Distribution in Annex C;

— introduction of information about some standards implementing the conceptual schema described in this document in Annex C;

— additional example illustrating Secondary Linear Referencing Systems in Annex E;

— the correction of minor errors;

— introduction of a detailed overview regarding changes and backwards compatibility in Annex F.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document 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[12] first standardized within ISO 19133:2005. This document extends that which was included in ISO 19133, both in functionality and explanation.

ISO 19109 supports features representing discrete objects with attributes with 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 with 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, ensuring that the linear segments are homogeneous in value for these segmenting attributes.

In accordance with the ISO/IEC Directives, Part 2, 2018, Rules for the structure and drafting of International Standards, in International Standards the decimal sign is a comma on the line. However, the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures) at its meeting in 2003 passed unanimously the following resolution:

“The decimal marker shall be either a point on the line or a comma on the line.” In practice, the choice between these alternatives depends on customary use in the language concerned. In the technical areas of geodesy and geographic information it is customary for the decimal point always to be used, for all languages. That practice is used throughout this document.

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Geographic information — Linear referencing

1 Scope

This document 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 document is applicable to transportation, utilities, environmental protection, location-based services and other applications which define locations relative to linear objects. For ease of reading, most examples discussed in this document come from the transportation domain.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19103, *Geographic information — Conceptual schema language*

ISO 19107, *Geographic information — Spatial schema*

ISO 19108, *Geographic information — Temporal schema*

ISO 19111, *Geographic information — Referencing by coordinates*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
attribute event
value of an attribute of a *feature* (3.4) that can apply to only part of the feature

Note 1 to entry: An attribute event includes the *linearly referenced location* (3.16) where the attribute value applies along the *attributed feature* (3.2).

Note 2 to entry: An attribute event can be qualified by the *instant* (3.8) in which, or *period* (3.20) during which, the attribute value applied.

3.2
attributed feature
feature (3.4) along which an *attribute event* (3.1) applies

3.3
direct position
position (3.21) described by a single set of coordinates within a coordinate reference system

[SOURCE: ISO 19136-1:2020, 3.1.20]

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3.4
feature
abstraction of real-world phenomena

[SOURCE: ISO 19101-1:2014, 4.1.11]

3.5
feature event
information about the occurrence of a *located feature* (3.17) along a *locating feature* (3.18)

Note 1 to entry: A feature event includes the *linearly referenced location* (3.16) of the located feature along the locating feature.

Note 2 to entry: A feature event can be qualified by the *instant* (3.8) in which, or *period* (3.20) during which, the feature event occurred.

3.6
geometric primitive
<geometry> geometric object representing a single, connected, homogeneous (isotropic) element of space

Note 1 to entry: Geometric primitives are non-decomposed objects that present information about geometric configuration. They include points, curves, surfaces and solids. Many geometric objects behave like primitives (supporting the same interfaces defined for geometric primitives) but are actually composites composed of some number of other primitives. General collections can be aggregates and incapable of acting like a primitive (such as the lines of a complex network, which is not connected and thus incapable of being traceable as a single line). By this definition, a geometric primitive is topological open, since the boundary points are not isotropic to the interior points. Geometry is assumed to be closed. For points, the boundary is empty.

[SOURCE: ISO 19107:2019, 3.50]

3.7
height
h, H
distance of a point from a chosen reference surface positive upward along a line perpendicular to that surface

Note 1 to entry: A height below the reference surface will have a negative value.

Note 2 to entry: Generalization of ellipsoidal height (h) and gravity-related height (H).

[SOURCE: ISO 19111:2019, 3.1.38]

3.8
instant
0-dimensional *geometric primitive* (3.6) representing *position* (3.21) in time

Note 1 to entry: The geometry of time is discussed in ISO 19108:2002, 5.2.

[SOURCE: ISO 19108:2002, 4.1.17]

3.9
linear element
one-dimensional object that serves as the axis along which measurements are made

Note 1 to entry: Also known as curvilinear element.

EXAMPLE *Feature* (3.4), such as “road”; curve geometry; directed edge topological primitive.

3.10
linear referencing
specification of a *location* (3.19) relative to a *linear element* (3.9) as a measurement along (and optionally offset from) that element

Note 1 to entry: An alternative to specifying a location as a two- or three- dimensional *spatial position* (3.23).

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3.11
linear referencing method
LRM
manner in which measurements are made along (and optionally offset from) a *linear element* (3.9)

3.12
linear referencing system
LRS
set of *linear referencing methods* (3.11) and the policies, records and procedures for implementing them

Note 1 to entry: Adapted from Reference [10].

3.13
linear segment
part of a linear *feature* (3.4) that is distinguished from the remainder of that feature by a subset of attributes, each having a single value for the entire part

Note 1 to entry: A linear segment is a one-dimensional object without explicit geometry.

Note 2 to entry: The implicit geometry of the linear segment can be derived from the geometry of the parent feature.

3.14
linearly located
located using a *linear referencing system* (3.12)

3.15
linearly located event
occurrence along a *feature* (3.4) of an attribute value or another feature

Note 1 to entry: The event *location* (3.19) is specified using *linearly referenced locations* (3.16).

Note 2 to entry: A linearly located event can be qualified by the *instant* (3.8) in which, or *period* (3.20) during which, the linearly located event occurred.

Note 3 to entry: ISO 19108 limits events to a single instant in time and does not include the specification of a location.

3.16
linearly referenced location
location (3.19) whose *position* (3.21) is specified using *linear referencing* (3.10)

3.17
located feature
linearly located feature
feature (3.4) that is *linearly located* (3.14) along an associated (locating) feature

EXAMPLE A feature “bridge” can be a located feature along the feature “railway” [a *locating feature* (3.18)].

3.18
locating feature
linearly locating feature
feature (3.4) that is used to identify the *location* (3.19) of *linearly located* (3.14) features

EXAMPLE A feature “road” can be the locating feature for a feature “pedestrian crossing” [a *located feature* (3.17)].

3.19
location
particular place or *position* (3.21)

Note 1 to entry: A location identifies a geographic place.

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Note 2 to entry: “Madrid”, “California”.

Note 3 to entry: Additionally, in this document, a location is represented by one of a set of data types that describe a *position* (3.21), along with metadata about that data, including coordinates (from a coordinate reference system), a measure (from a *linear referencing system* (3.12)), or an address (from an address system).

[SOURCE: ISO 19112:2019, 3.1.3]

3.20
period
one-dimensional *geometric primitive* (3.6) representing extent in time

Note 1 to entry: A period is bounded by two different *temporal positions* (3.24).

[SOURCE: ISO 19108:2002, 4.1.27]

3.21
position
data type that describes a point or geometry potentially occupied by an object or person

Note 1 to entry: A *direct position* (3.3) is a semantic subtype of position. Direct positions as described can define only a point and, therefore, not all positions can be represented by a direct position. That is consistent with the “is type of” relation. An ISO 19107 geometry is also a position, just not a direct position.

[SOURCE: ISO 19133:2005, 4.18]

3.22
referent
known *location* (3.19) along a *linear element* (3.9) from which relative measurements are made

EXAMPLE Milepost, kilopost or reference post.

3.23
spatial position
direct position (3.3) that is referenced to a two- or three-dimensional coordinate reference system

Note 1 to entry: An alternative to specifying a *location* (3.19) as a *linearly referenced location* (3.16).

3.24
temporal position
location (3.19) relative to a *temporal reference system* (3.25)

[SOURCE: ISO 19108:2002, 4.1.34]

3.25
temporal reference system
reference system against which time is measured

[SOURCE: ISO 19108:2002, 4.1.35]

3.26
valid time
time when a fact is true in the abstracted reality

[SOURCE: ISO 19108:2002, 4.1.39]

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