INTERNATIONAL STANDARD

ISO 19136-1

First edition
2020-01

Geographic information — Geography Markup Language (GML) —

Part 1: **Fundamentals**

Reference number
ISO 19136-1:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ... **x**
Introduction ... **xii**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms, definitions, symbols and abbreviated terms ... **2**
3.1 Terms and definitions ... 2
3.2 Abbreviated terms ... 9
4 Conformance ... **10**
4.1 Conformance requirements ... 10
4.2 Conformance classes related to GML application schemas ... 10
4.3 Conformance classes related to GML profiles ... 11
4.4 Conformance classes related to GML documents ... 12
4.5 Conformance classes related to software implementations ... 12
5 Conventions ... **13**
5.1 XML namespaces ... 13
5.2 Versioning ... 13
5.3 Deprecated parts of previous versions of GML ... 13
5.4 UML notation ... 13
5.5 XML Schema ... 15
6 Overview of the GML schema ... **15**
6.1 GML schema ... 15
6.2 GML application schemas ... 15
6.3 Relationship between the ISO 19100 series of International Standards, the GML schema and GML application schemas ... 16
6.4 Organization of this document ... 17
6.5 Deprecated and experimental schema components ... 18
7 GML schema — General rules and base schema components ... **19**
7.1 GML model and syntax ... 19
7.1.1 GML instance documents ... 19
7.1.2 Lexical conventions ... 20
7.1.3 XML Schema definition of GML language ... 20
7.2 gmlBase schema components ... 21
7.2.1 Goals of base schema components ... 21
7.2.2 Base objects ... 21
7.2.3 GML properties ... 22
7.2.4 Standard properties of GML objects ... 27
7.2.5 Collections of GML objects ... 27
7.2.6 Metadata ... 28
8 GML schema — Xlinks and basic types ... **31**
8.1 Xlinks — Object associations and remote properties ... 31
8.2 Basic types ... 33
8.2.1 Overview ... 33
8.2.2 Relationship with ISO 19103 ... 33
8.2.3 Simple types ... 33
8.2.4 Lists ... 38
9 GML schema — Features ... **40**
9.1 General concepts ... 40
9.2 Relationship with ISO 19109 ... 40
9.3 Features ... 41
9.3.1 AbstractFeatureType ... 41
9.3.2 AbstractFeature ... 41

9.4 Standard feature properties ... 41
9.4.1 boundedBy, BoundingShapeType, EnvelopeWithTimePeriod, EnvelopeWithTimePeriodType ... 41
9.4.2 locationName, locationReference ... 42
9.4.3 FeaturePropertyType, FeatureArrayPropertyType ... 43
9.5 Geometry properties ... 43
9.6 Topology properties ... 44
9.7 Temporal properties ... 45
9.8 Defining application-specific feature types ... 46
9.9 Feature collections ... 47
9.9.1 GML feature collections ... 47
9.9.2 AbstractFeatureMemberType and derived property types ... 48
9.10 Spatial reference system used in a feature or feature collection ... 48

10 GML schema — Geometric primitives ... 49
10.1 General concepts ... 49
10.1.1 Overview ... 49
10.1.2 Relationship with ISO 19107 ... 49
10.1.3 Abstract geometry ... 50
10.1.4 Coordinate geometry, vectors and envelopes ... 52
10.2 Abstract geometric primitives ... 54
10.2.1 AbstractGeometricPrimitiveType, AbstractGeometricPrimitive ... 54
10.2.2 GeometricPrimitivePropertyType ... 55
10.3 Geometric primitives (0-dimensional) ... 55
10.3.1 PointType, Point ... 55
10.3.2 PointPropertyType, pointProperty ... 55
10.3.3 PointArrayPropertyType, pointArrayProperty ... 56
10.4 Geometric primitives (1-dimensional) ... 56
10.4.1 AbstractCurveType, AbstractCurve ... 56
10.4.2 CurvePropertyType, curveProperty ... 56
10.4.3 CurveArrayPropertyType, curveArrayProperty ... 57
10.4.4 LineStringType, LineString ... 57
10.4.5 CurveType, Curve ... 57
10.4.6 OrientableCurveType, OrientableCurve, baseCurve ... 58
10.4.7 Curve segments ... 58
10.5 Geometric primitives (2-dimensional) ... 67
10.5.1 AbstractSurfaceType, AbstractSurface ... 67
10.5.2 SurfacePropertyType, surfaceProperty ... 68
10.5.3 SurfaceArrayPropertyType, surfaceArrayProperty ... 68
10.5.4 PolygonType, Polygon ... 68
10.5.5 exterior, interior ... 68
10.5.6 AbstractRingType, AbstractRing ... 69
10.5.7 AbstractRingPropertyType ... 69
10.5.8 LinearRingType, LinearRing ... 69
10.5.9 LinearRingPropertyType ... 70
10.5.10 SurfaceType, Surface ... 70
10.5.11 OrientableSurfaceType, OrientableSurface, baseSurface ... 70
10.5.12 Surface patches ... 72
10.6 Geometric primitives (3-dimensional) ... 76
10.6.1 AbstractSolidType, AbstractSolid ... 76
10.6.2 SolidPropertyType, solidProperty ... 76
10.6.3 SolidArrayPropertyType, solidArrayProperty ... 77
10.6.4 SolidType, Solid ... 77
10.6.5 ShellType, Shell ... 77
10.6.6 ShellPropertyType ... 78

11 GML schema — Geometric complex, geometric composites and geometric aggregates ... 78
11.1 Overview ... 78
11.2 Geometric complex and geometric composites ... 79

11.2.1 Geometric complex 79
11.2.2 Composite geometries 79
11.3 Geometric aggregates 81
11.3.1 Aggregates of unspecified dimensionality 81
11.3.2 0-Dimensional aggregates 82
11.3.3 1-Dimensional aggregates 83
11.3.4 2-Dimensional aggregates 84
11.3.5 3-Dimensional aggregates 85

12 GML schema — Coordinate reference systems schemas 85
12.1 Overview 85
12.1.1 General 85
12.1.2 Relationship with ISO 19111 86
12.1.3 Important XML elements 86
12.2 Reference systems 87
12.2.1 Overview 87
12.2.2 IdentifiedObjectType 88
12.2.3 Abstract coordinate reference system 88
12.3 Coordinate reference systems 89
12.3.1 Overview 89
12.3.2 Abstract coordinate reference systems 89
12.3.3 Concrete coordinate reference systems 90
12.4 Coordinate systems 96
12.4.1 Overview 96
12.4.2 Coordinate system axes 96
12.4.3 Abstract coordinate system 97
12.4.4 Concrete coordinate systems 98
12.5 Datums 103
12.5.1 Overview 103
12.5.2 Abstract datum 103
12.5.3 Geodetic datum 104
12.5.4 Other concrete datums 106
12.6 Coordinate operations 108
12.6.1 Overview 108
12.6.2 Abstract coordinate operations 109
12.6.3 Concrete coordinate operations 112
12.6.4 Parameter values and groups 115
12.6.5 Operation method 117
12.6.6 Operation parameters and groups 118

13 GML schema — Topology 120
13.1 General concepts 120
13.1.1 Overview 120
13.1.2 Relationship with ISO 19107 120
13.2 Abstract topology 121
13.3 Topological primitives 121
13.3.1 Abstract topological primitives 121
13.3.2 Topological primitives (0-dimensional) 121
13.3.3 Topological primitives (1-dimensional) 122
13.3.4 Topological primitives (2-dimensional) 123
13.3.5 Topological primitives (3-dimensional) 124
13.4 Topological collections 125
13.4.1 Topological collection (0-dimensional) 125
13.4.2 Topological collection (1-dimensional) 126
13.4.3 Topological collection (2-dimensional) 126
13.4.4 Topological collection (3-dimensional) 127
13.5 Topology complex 127
13.5.1 TopoComplexType, TopoComplex 127
13.5.2 Maximal, sub- and super-complexes 128

13.5.3 topoPrimitiveMember 128
13.5.4 topoPrimitiveMembers 128
13.5.5 TopoComplexPropertyType, topoComplexProperty 128

14 GML schema — Temporal information and dynamic features 129
14.1 General concepts 129
14.1.1 Overview 129
14.1.2 Relationship with ISO 19108 130
14.2 Temporal schema 130
14.2.1 Abstract temporal objects 130
14.2.2 Temporal geometry 132
14.3 Temporal topology schema 137
14.3.1 General 137
14.3.2 Temporal topology objects 137
14.4 Temporal reference systems 140
14.4.1 Overview 140
14.4.2 Basic temporal reference system, TimeReferenceSystem 140
14.4.3 TimeCoordinateSystem 141
14.4.4 Calendars and clocks 142
14.4.5 Ordinal temporal reference systems 144
14.5 Representing dynamic features 146
14.5.1 Overview 146
14.5.2 dataSource 146
14.5.3 Dynamic properties 147
14.5.4 DynamicFeature 147
14.5.5 DynamicFeatureCollection 147
14.5.6 AbstractTimeSlice 148
14.5.7 history 149

15 GML schema — Definitions and dictionaries 150
15.1 Overview 150
15.2 Dictionary schema 151
15.2.1 Definition, DefinitionType, remarks 151
15.2.2 Dictionary, DictionaryType 151
15.2.3 dictionaryEntry, DictionaryEntryType 152
15.2.4 Using definitions and dictionaries 152

16 GML schema — Units, measures and values 153
16.1 Introduction 153
16.2 Units schema 154
16.2.1 Overview 154
16.2.2 Using unit definitions 154
16.2.3 unitOfMeasure, UnitOfMeasureType 154
16.2.4 UnitDefinition, UnitDefinitionType 155
16.2.5 quantityType, quantityTypeReference 155
16.2.6 catalogSymbol 155
16.2.7 BaseUnit, BaseUnitType, unitsSystem 155
16.2.8 DerivedUnit, DerivedUnitType 156
16.2.9 derivationUnitTerms, DerivationUnitTermType 156
16.2.10 ConventionalUnit, ConventionalUnitType 156
16.2.11 conversionToPreferredUnit, roughConversionToPreferredUnit, ConversionToPreferredUnitType, FormulaType 157
16.2.12 Example of units dictionary <informative> 158
16.3 Measures schema 159
16.3.1 Overview 159
16.3.2 measure 159
16.3.3 Scalar measure types 159
16.3.4 angle 160
16.4 Value objects schema 160
16.4.1 Introduction 160

16.4.2 Value element hierarchy ... 160
16.4.3 Boolean, BooleanList ... 161
16.4.4 Category, CategoryList ... 161
16.4.5 Count, CountList ... 162
16.4.6 Quantity, QuantityList ... 162
16.4.7 AbstractValue, AbstractScalarValue, AbstractScalarValueList ... 163
16.4.8 Value ... 163
16.4.9 valueProperty, valueComponent, valueComponents ... 163
16.4.10 CompositeValue ... 164
16.4.11 ValueArray ... 165
16.4.12 Typed ValueExtents: CategoryExtent, CountExtent, QuantityExtent ... 166
16.4.13 BooleanPropertyType, CategoryPropertyType, CountPropertyType, QuantityPropertyType ... 167

17 GML schema — Directions ... 167
17.1 Direction schema ... 167
17.2 direction, DirectionPropertyType ... 167
17.3 DirectionVectorType ... 167
17.4 DirectionDescriptionType ... 168

18 GML schema — Observations ... 169
18.1 Observations ... 169
18.2 Observation schema ... 169
18.2.1 Overview ... 169
18.2.2 Observation ... 169
18.2.3 using ... 170
18.2.4 target ... 170
18.2.5 resultOf ... 171
18.2.6 DirectedObservation ... 171
18.2.7 DirectedObservationAtDistance ... 172

19 GML schema — Coverages ... 173
19.1 The coverage model and representations ... 173
19.1.1 General remarks ... 173
19.1.2 Formal description of a coverage ... 174
19.1.3 Coverage in GML ... 174
19.1.4 Relationship with ISO 19123 ... 175
19.2 Grids schema ... 175
19.2.1 Overview ... 175
19.2.2 Grid ... 175
19.2.3 RectifiedGrid ... 176
19.3 Coverage schema ... 178
19.3.1 AbstractCoverageType, AbstractCoverage ... 178
19.3.2 DiscreteCoverageType, AbstractDiscreteCoverage ... 178
19.3.3 AbstractContinuousCoverageType, AbstractContinuousCoverage ... 178
19.3.4 domainSet, DomainSetType ... 179
19.3.5 rangeSet, RangeSetType ... 179
19.3.6 DataBlock ... 180
19.3.7 rangeParameters ... 180
19.3.8 tupleList ... 180
19.3.9 doubleOrNilReasonTupleList ... 181
19.3.10 File, FileType ... 181
19.3.11 coverageFunction, CoverageFunctionType ... 182
19.3.12 CoverageMappingRule ... 183
19.3.13 GridFunction, GridFunctionType ... 184
19.3.14 sequenceRule, SequenceRuleType, SequenceRuleEnumeration ... 184
19.3.15 Specific Coverage Types in GML ... 185
19.3.16 MultiPointCoverage ... 185
19.3.17 MultiCurveCoverage ... 186
19.3.18 MultiSurfaceCoverage ... 187

19.3.19 MultiSolidCoverage ... 189
19.3.20 GridCoverage ... 189
19.3.21 RectifiedGridCoverage ... 190

20 Profiles ... 191
20.1 Profiles of GML and application schemas ... 191
20.2 Definition of profile ... 191
20.3 Relation to application schema ... 191
20.4 Rules for elements and types in a profile ... 192
20.5 Rules for referencing GML profiles from application schemas ... 192
20.6 Recommendations for application schemas using GML profiles ... 193
20.7 Summary of rules for GML profiles ... 193

21 Rules for GML application schemas ... 194
21.1 Instances of GML objects ... 194
21.1.1 GML documents ... 194
21.1.2 GML object elements in other XML documents ... 194
21.2 GML application schemas ... 194
21.2.1 General ... 194
21.2.2 Target namespace ... 196
21.2.3 Import GML schema ... 196
21.2.4 Object type derivation ... 196
21.2.5 Elements representing objects ... 196
21.2.6 Property type derivation ... 196
21.2.7 Elements representing properties ... 197
21.3 Schemas defining Features and Feature Collections ... 197
21.3.1 General ... 197
21.3.2 Import GML schema components ... 197
21.3.3 Elements representing features ... 198
21.3.4 Application features are features ... 198
21.4 Schemas defining spatial geometries ... 198
21.4.1 Import GML geometry schema components ... 198
21.4.2 User-defined geometry types and geometry property types ... 198
21.5 Schemas defining spatial topologies ... 199
21.5.1 Import GML topology schema components ... 199
21.5.2 User-defined topology types and topology property types ... 200
21.6 Schemas defining time ... 200
21.6.1 Import GML temporal schema components ... 200
21.6.2 User-defined temporal types and temporal property types ... 200
21.7 Schemas defining coordinate reference systems ... 201
21.7.1 General ... 201
21.7.2 Import GML coordinate reference system schema components ... 202
21.8 Schemas defining coverages ... 202
21.8.1 General ... 202
21.8.2 Import GML coverage schema components ... 202
21.8.3 User-defined coverage types ... 202
21.8.4 Range parameters shall be substitutable for AbstractValue ... 202
21.8.5 Coverage document ... 203
21.9 Schemas defining observations ... 203
21.9.1 General ... 203
21.9.2 Import GML observation schema components ... 203
21.9.3 User-defined observation types ... 204
21.9.4 Observation collections ... 204
21.9.5 Observations are features ... 204
21.9.6 Observation collection document ... 204
21.10 Schemas defining dictionaries and definitions ... 204
21.10.1 General ... 204
21.10.2 Import GML dictionary schema components ... 204
21.10.3 User-defined definition types ... 204

21.10.4 User-defined dictionary types 205
21.11 Schemas defining values 205
21.11.1 General 205
21.11.2 Import GML value objects schema components 205
21.11.3 Construction of new value types 205
21.12 GML profiles of the GML schema 205

Annex A (normative) **Abstract test suites for GML application schemas, GML profiles and GML documents** **208**

Annex B (normative) **Abstract test suite for software implementations** **222**

Annex C (informative) **GML schema** **226**

Annex D (normative) **Implemented profile of the ISO 19100 series of International Standards and extensions** **228**

Annex E (normative) **UML-to-GML application schema encoding rules** **289**

Annex F (normative) **GML-to-UML application schema encoding rules** **308**

Annex G (informative) **Guidelines for subsetting the GML schema** **317**

Annex H (informative) **Default styling** **329**

Annex I (informative) **Backwards compatibility with earlier versions of GML** **339**

Annex J (informative) **Modularization and dependencies** **355**

Bibliography **357**

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

This first edition of ISO 19136-1 cancels and replaces ISO 19136:2007 which has been technically revised.

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

— The Geography Markup Language (GML) was originally developed within the Open Geospatial Consortium, Inc. (OGC). ISO 19136 was prepared by ISO/TC 211 jointly with the OGC. This edition of this document is a revision to GML 3.2.1 (ISO 19136:2007). It addresses the OGC Change Request 12-092 (gml:id attribute on LinearRing) by applying the following changes:

  — the XML attribute gml:id in gml:AbstractGMLType has been made optional;

  — the elements gml:AbstractRing and gml:Shell have been added to the substitutionGroups gml:AbstractCurve and gml:AbstractSurface respectively;

  — the types gml:AbstractRingType and gml:ShellType are now extended from base types gml:AbstractCurveType and gml:AbstractSurfaceType respectively;

These changes correct inconsistencies with ISO 19107 without breaking the validity of instance documents created using the GML 3.2.1 schema. i.e. all GML 3.2 instance documents that are valid against the GML 3.2.1 schema are also valid against the GML 3.2.2 schema.

The corrected GML 3.2 schema is available at http://schemas.opengis.net/gml/3.2.1/. Note that the use of "3.2.1" in the URL is unchanged since this version (3.2.2) replaces the GML 3.2.1 schema. Previous versions of the GML 3.2.1 schema are available at http://schemas.opengis.net/gml/gml-3_2_1.zip.

The change to the gml:id attribute reverts a change that has been made between GML 3.1.1 and GML 3.2.1. Reverting this change also addresses comments raised by several communities since the release of GML 3.2.1 / ISO 19136:2007.

As the correction relaxes a constraint in the XML schema, not all instance documents created based on the GML 3.2.2 schema will be valid against the GML 3.2.1 schema:

— all GML 3.2 instance documents that include a gml:id attribute on a ring or shell element are not valid against the GML 3.2.1 schema;

— all GML 3.2 instance documents that include a feature, a spatial object or a temporal object without a gml:id attribute are not valid against the GML 3.2.1 schema.

Local copies of the GML 3.2.1 schema documents have to be replaced by the GML 3.2.2 schema documents – or be replaced by links to http://schemas.opengis.net/gml/3.2.1/gml.xsd.

— URIs have been updated, mainly in examples, where OGC policies have changed since the release of GML 3.2.1 (location of the Xlink schema document, use of OGC HTTP URIs for coordinate reference systems).

— The reference to the normative schema documents in Annex C now refers to the OGC schema repository. Previously, copies of the GML schema were also published on ISO servers, but the schema documents were not always synchronized. Going forward, all references to the normative GML schema document should go to http://schemas.opengis.net/gml/.

A list of all parts in the ISO 19136 series can be found on the ISO website.

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

Introduction

Geography Markup Language (GML) is an XML grammar written in XML Schema for the description of application schemas as well as the transport and storage of geographic information.

The key concepts used by GML to model the world are drawn from the ISO 19100 series of International Standards and the OpenGIS Abstract Specification.

A feature is an "abstraction of real world phenomena" (ISO 19101); it is a geographic feature if it is associated with a location relative to the Earth so a digital representation of the real world may be thought of as a set of features. The state of a feature is defined by a set of properties, where each property may be thought of as a {name, type, value} triple.

The number of properties a feature may have, together with their names and types, is determined by its type definition. Geographic features with geometry are those with properties that may be geometry-valued. A feature collection is a collection of features that may itself be regarded as a feature; as a consequence a feature collection has a feature type and thus may have distinct properties of its own, in addition to the features it contains.

Following ISO 19109, the feature types of an application or application domain is usually captured in an application schema. A GML application schema is specified in XML Schema and can be constructed in two different and alternative ways:

— by adhering to the rules specified in ISO 19109 for application schemas in UML, and conforming to both the constraints on such schemas and the rules for mapping them to GML application schemas specified in this document;

— by adhering to the rules for GML application schemas specified in this document for creating a GML application schema directly in XML Schema.

Both ways are supported by this document. To ensure proper use of the conceptual modelling framework of the ISO 19100 series of International Standards, all application schemas are expected to be modelled in accordance with the General Feature Model as specified in ISO 19109. Within the ISO 19100 series, UML is the preferred language by which to model conceptual schemas.

GML specifies XML encodings, conformant with ISO 19118, of several of the conceptual classes defined in the ISO 19100 series of International Standards and the OpenGIS Abstract Specification. These conceptual models include those defined in:

— ISO/TS 19103 — Conceptual schema language (units of measure, basic types);

— ISO 19107 — Spatial schema (geometry and topology objects);

— ISO 19108 — Temporal schema (temporal geometry and topology objects, temporal reference systems);

— ISO 19109 — Rules for application schemas (features);

— ISO 19111 — Spatial referencing by coordinates (coordinate reference systems);

— ISO 19123 — Schema for coverage geometry and functions.

The aim is to provide a standardized encoding (i.e. a standardized implementation in XML) of types specified in the conceptual models specified by the International Standards listed above. If every application schema were encoded independently and the encoding process included the types from, for example, ISO 19108, then, without unambiguous and completely fixed encoding rules, the XML encodings would be different. Also, since every implementation platform has specific strengths and weaknesses, it is helpful to standardize XML encodings for core geographic information concepts modelled in the ISO 19100 series of International Standards and commonly used in application schemas.

In many cases, the mapping from the conceptual classes is straightforward, while in some cases the mapping is more complex (a detailed description of the mapping is part of this document).

In addition, GML provides XML encodings for additional concepts not yet modelled in the ISO 19100 series of International Standards or the OpenGIS Abstract Specification, for example, dynamic features, simple observations or value objects.

Predefined types of geographic features in GML include coverages and simple observations.

A coverage is a subtype of feature that has a coverage function with a spatiotemporal domain and a value set range of homogeneous 1- to *n*-dimensional tuples. A coverage may represent one feature or a collection of features "to model and make visible spatial relationships between, and the spatial distribution of, Earth phenomena" (OGC Abstract Specification Topic 6[18]) and a coverage "acts as a function to return values from its range for any direct position within its spatiotemporal domain" (ISO 19123).

An observation models the act of observing, often with a camera or some other procedure, a person or some form of instrument (Merriam-Webster Dictionary: "an act of recognizing and noting a fact or occurrence often involving measurement with instruments"). An observation is considered to be a GML feature with a time at which the observation took place, and with a value for the observation.

A reference system provides a scale of measurement for assigning values to a position, time or other descriptive quantity or quality.

A coordinate reference system consists of a set of coordinate system axes that is related to the Earth through a datum that defines the size and shape of the Earth.

A temporal reference system provides standard units for measuring time and describing temporal length or duration.

A reference system dictionary provides definitions of reference systems used in spatial or temporal geometries.

Spatial geometries are the values of spatial feature properties. They indicate the coordinate reference system in which their measurements have been made. The "parent" geometry element of a geometric complex or geometric aggregate makes this indication for its constituent geometries.

Temporal geometries are the values of temporal feature properties. Like their spatial counterparts, temporal geometries indicate the temporal reference system in which their measurements have been made.

Spatial or temporal topologies are used to express the different topological relationships between features.

A units of measure dictionary provides definitions of numerical measures of physical quantities, e.g. length, temperature and pressure, and of conversions between units.

NOTE This document makes reference to ISO 19107:2003 and ISO 19111:2007 (withdrawn standards, replaced by 2019 versions) because this edition of ISO 19136-1 is still an XML implementation of the previous edition of ISO 19107 and other standards.

Geographic information — Geography Markup Language (GML) —

Part 1: Fundamentals

1 Scope

The Geography Markup Language (GML) is an XML encoding in accordance with ISO 19118 for the transport and storage of geographic information modelled in accordance with the conceptual modelling framework used in the ISO 19100 series of International Standards and including both the spatial and non-spatial properties of geographic features.

This document defines the XML Schema syntax, mechanisms and conventions that:

— provide an open, vendor-neutral framework for the description of geospatial application schemas for the transport and storage of geographic information in XML;

— allow profiles that support proper subsets of GML framework descriptive capabilities;

— support the description of geospatial application schemas for specialized domains and information communities;

— enable the creation and maintenance of linked geographic application schemas and datasets;

— support the storage and transport of application schemas and datasets;

— increase the ability of organizations to share geographic application schemas and the information they describe.

Implementers can decide to store geographic application schemas and information in GML, or they can decide to convert from some other storage format on demand and use GML only for schema and data transport.

NOTE If an ISO 19109 conformant application schema described in UML is used as the basis for the storage and transportation of geographic information, this document provides normative rules for the mapping of such an application schema to a GML application schema in XML Schema and, as such, to an XML encoding for data with a logical structure in accordance with the ISO 19109 conformant application schema.

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 8601-1, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO/IEC 11404:2007, *Information technology — General-Purpose Datatypes (GPD)*

ISO 19108:2002, *Geographic information — Temporal schema*

ISO 19123:2005, *Geographic information — Schema for coverage geometry and functions*

ISO/IEC 19757-3, *Information technology — Document Schema Definition Languages (DSDL) — Part 3: Rule-based validation — Schematron*

ISO 80000-3, *Quantities and units — Part 3: Space and time*

IETF RFC 2396, *Uniform Resource Identifiers (URI): Generic Syntax (August 1998)*

W3C XLink, XML Linking Language (XLink) Version 1.1, W3C Recommendation (6 May 2010)

W3C XML, Extensible Markup Language (XML) 1.0 (Fith Edition), W3C Recommendation (26 November 2008)

W3C XML Namespaces, Namespaces in XML 1.0 (Third Edition), W3C Recommendation (8 December 2009)

W3C XML Schema Part 1, XML Schema Part 1: Structures, W3C Recommendation (28 October 2004)

W3C XML Schema Part 2, XML Schema Part 2: Datatypes, W3C Recommendation (28 October 2004)

3 Terms, definitions, symbols and abbreviated terms

3.1 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/

3.1.1
application schema
conceptual *schema* (3.1.52) for data required by one or more applications

[SOURCE: ISO 19101-1:2014, 4.1.2]

3.1.2
association
<UML> semantic relationship that can occur between typed instances

[SOURCE: ISO 19103:2015, 4.4, modified — Note 1 to entry has been deleted.]

3.1.3
attribute
<XML> name-value pair contained in an *element* (3.1.23)

Note 1 to entry: In this document an attribute is an XML attribute unless otherwise specified. The syntax of an XML attribute is “Attribute::= Name = AttValue”. An attribute typically acts as an XML element modifier (e.g. <Road gml:id = “r1” />; here gml:id is an attribute).

3.1.4
boundary
set that represents the limit of an entity

[SOURCE: ISO 19107:2019, 3.6, modified — Note 1 to entry has been deleted.]

3.1.5
child element
<XML> immediate descendant *element* of an *element* (3.1.23)