INTERNATIONAL STANDARD

ISO
19137

Geographic information — Core profile of the spatial schema

Information géographique — Profil minimal du schéma spatial

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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.

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.

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ISO 19137 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

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Introduction

This International Standard provides a core profile of the geometry part of the spatial schema specified in ISO 19107 that is easy to understand and has a low cost of implementation. The profile is intentionally small and limited in order to increase the chance of gaining widespread market acceptance.

A simple topology package extension of the profile might be developed as a future part of this International Standard. Many user communities have requirements that go beyond the capabilities provided by this International Standard, and they may define custom profiles.

While ISO 19136 also implements a profile of ISO 19107, it is a comprehensive profile, not a core profile.

This International Standard supports data types for geometric primitives of 0, 1 and 2 dimensions. It satisfies the conformance test A.1.1.3 of ISO 19107:2003. It is in conformance class 1 of ISO 19106.

Annex A lists some specifications that were supported by this International Standard at the time of its publication. Annex B specifies an abstract test suite for determining whether an application schema or profile is conformant to the core profile. Annex C discusses how to extend the core profile. Annex D presents two examples.

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Geographic information — Core profile of the spatial schema

1 Scope

This International Standard defines a core profile of the spatial schema specified in ISO 19107 that specifies, in accordance with ISO 19106, a minimal set of geometric elements necessary for the efficient creation of application schemata.

This International Standard supports many of the spatial data formats and description languages already developed and in broad use within several nations or liaison organizations.

NOTE   Data modelled with this International Standard are consistent with spatial models already developed and used by a number of organizations; see Annex A.

2 Conformance

An abstract test suite for this International Standard is given in Annex B.

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 19107:2003, *Geographic information — Spatial schema*

ISO 19111:2003, *Geographic information — Spatial referencing by coordinates*

4 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the same terms, definitions, symbols and abbreviated terms given in ISO 19107 apply.

5 Geometry packages

5.1 Class diagram

Figure 1 depicts the complete profile of ISO 19107. The constraints on ISO 19107 are too many to be shown graphically in Figure 1, but are described in 5.2 to 5.12. This International Standard is limited to applications in which

⸺ there is a 1:1 mapping between features and geometric primitives,

⸺ all geometric primitives are referenced to a single coordinate reference system,

— all curves are composed of line segments, and

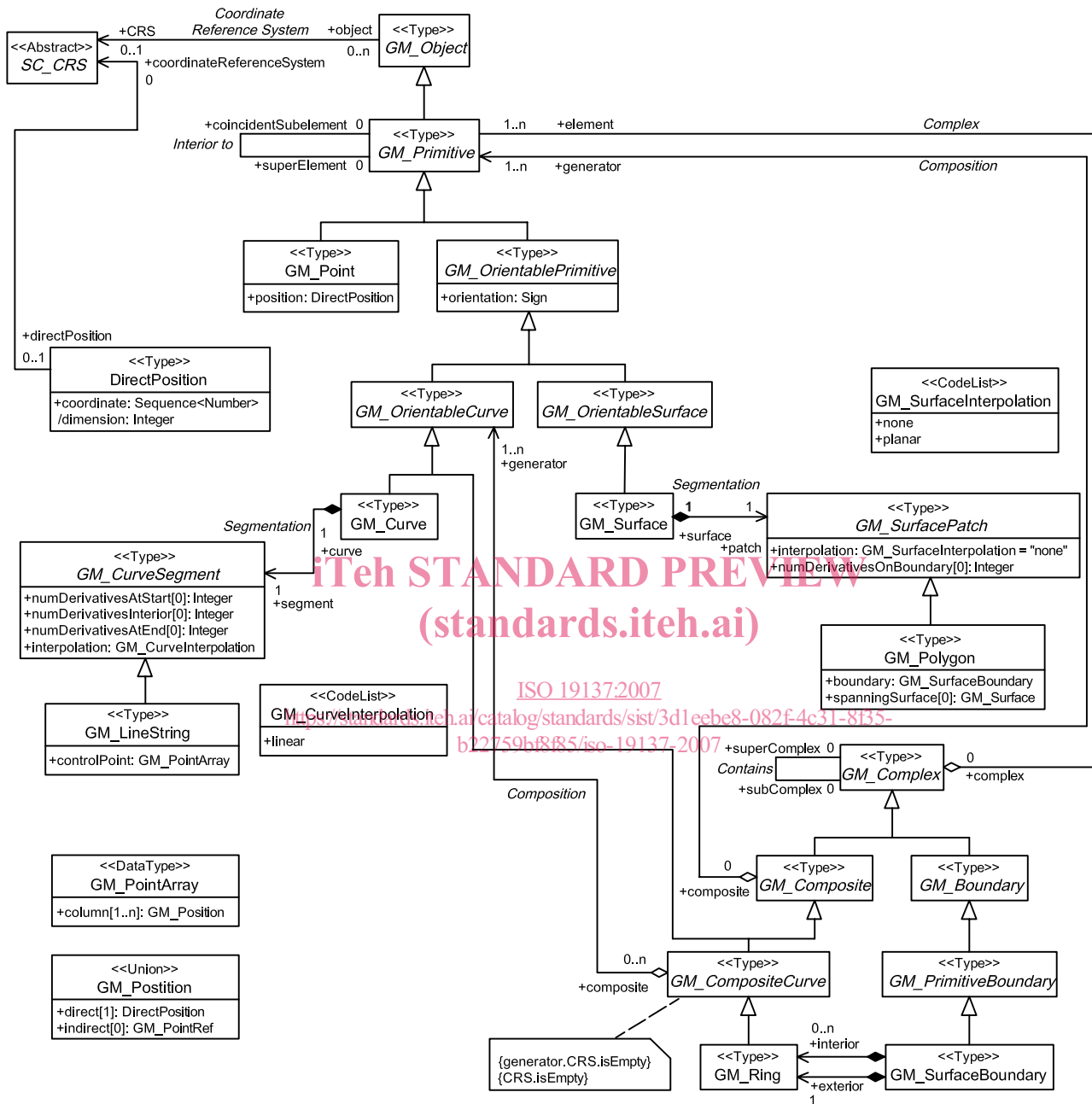— all surfaces are composed of planar facets.

Figure 1 — The complete profile

Abstract classes that appear in Figure 1 and are needed to provide compatibility with ISO 19107 are omitted from the simplified representation in Figure 2.

NOTE   Abstract classes that are needed for compatibility with ISO 19107 have been omitted. Also, the inheritance relation between GM_Ring and GM_Object is not shown here.
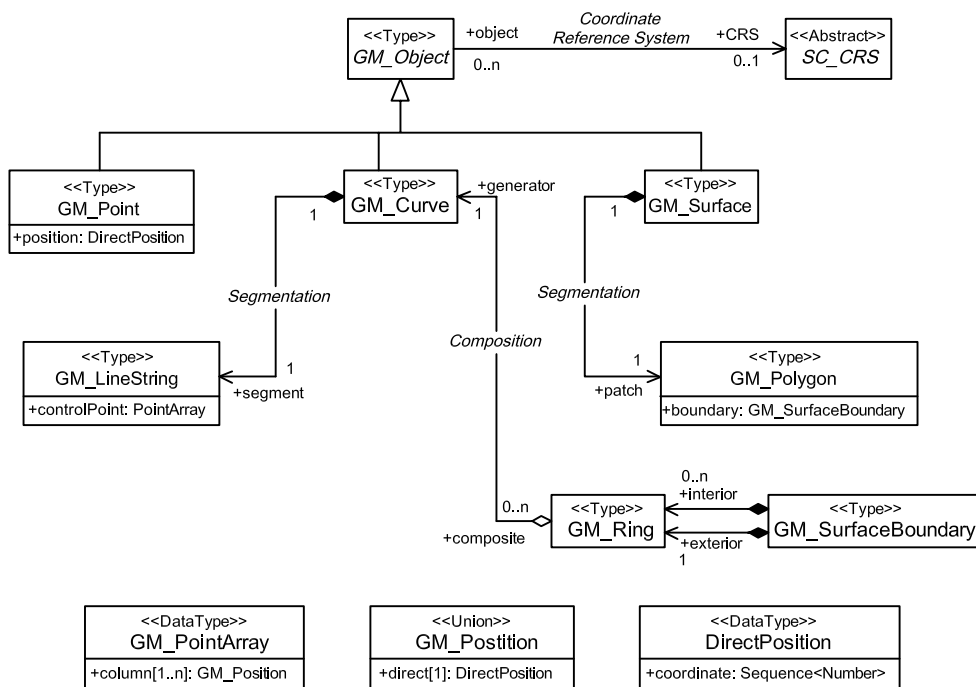
Figure 2 — A simplified, "flattened" view to the profile for illustrating its structure

5.2 Omitted constructs

This International Standard uses no operations or interfaces from ISO 19107. Also, any other constructs from ISO 19107 are omitted in this International Standard unless they are mentioned in 5.3.

5.3 Classes retained without additional constraints

The following classes are the same as in ISO 19107.

— **Abstract classes**: GM_Object (ISO 19107:2003, 6.2.2); GM_Boundary (6.3.2); GM_PrimitiveBoundary (6.3.4); GM_Primitive (6.3.10); GM_OrientablePrimitive (6.3.13); GM_Complex (6.6.2); GM_Composite (6.6.3).

— **Concrete classes**: GM_Ring (ISO 19107:2003, 6.3.6), GM_SurfaceBoundary (6.3.7); GM_Point (6.3.11); GM_Curve (6.3.16); GM_Surface (6.3.17); DirectPosition (6.4.1); GM_PointArray (6.4.6); GM_LineString (6.4.10).

Like ISO 19107, this International Standard refers to the abstract class SC_CRS, which is defined in ISO 19111.

5.4 Concrete classes made abstract

The following classes are concrete in ISO 19107, but abstract in this profile: GM_OrientableCurve (6.3.14); GM_OrientableSurface (6.3.15); GM_CompositeCurve (6.6.5).

5.5 Associations

5.5.1 Associations retained without additional constraints

The following associations are the same as in ISO 19107: Coordinate Reference System (ISO 19107:2003, 6.2.2.17); association "Composition" between GM_CompositeCurve and GM_OrientableCurve (ISO 19107:2003, Figure 28).

5.5.2 Segmentation between GM_Curve and GM_CurveSegment

The association "Segmentation" between GM_Curve and GM_CurveSegment (ISO 19107:2003, 6.3.16.3) is changed as follows: the multiplicity of the "curve" role is restricted from [0,1] to [1], and the multiplicity of the "segment" role is restricted from [1..n] to [1]. Instances of GM_CurveSegment thus cannot exist without being part of a GM_Curve.

```
GM_CurveSegment::curve[1] : Reference<GM_Curve> (multiplicity restricted from [0,1])
```

5.5.3 Segmentation between GM_Surface and GM_SurfacePatch

The association "Segmentation" between GM_Surface and GM_SurfacePatch (ISO 19107:2003, 6.3.17.3) is changed as follows: the multiplicity of the "surface" role is restricted from [0,1] to [1]. Instances of GM_SurfacePatch thus cannot exist without being part of a GM_Surface.

```
GM_SurfacePatch::surface[1] : Reference<GM_Surface> (multiplicity restricted from [0,1])
```

5.5.4 DirectPosition::coordinateReferenceSystem

The multiplicity of the association role "coordinateReferenceSystem" of the data type DirectPosition (ISO 19107:2003, 6.4.1.4) is restricted from [0,1] to [0]. As a consequence, individual points cannot specify a reference system; this has to be established via GM_Object::CRS.

The data in any dataset that conforms to this International Standard shall be in one and only one coordinate reference system.

```
DirectPosition::coordinateReferenceSystem[0] : ISO19111::SC_CRS    (multiplicity
restricted from [0,1])
```

5.5.5 GM_SurfaceBoundary::exterior

The multiplicity of the association role "exterior" of GM_SurfaceBoundary (ISO 19107:2003, 6.3.7.2) is restricted from [0,1] to [1]. Thus, all surfaces are required to have an exterior boundary and the "universe face" is not permitted in this International Standard.

```
GM_SurfaceBoundary::exterior[1] : GM_Ring (multiplicity restricted from [0,1])
```

5.5.6 Interior to

The multiplicity of the association roles "coincidentSubelement" and "superElement" of GM_Primitive (ISO 19107:2003, 6.3.10.4, association "Interior to") is restricted on both ends to [0]. Thus, this International Standard excludes GM_Primitives which are coincident with one another.

```
GM_Primitive::coincidentSubelement[0] : GM_Primitive (multiplicity restricted from [0..n])
GM_Primitive::superElement[0] : GM_Primitive (multiplicity restricted from [0..n])
```

NOTE   ISO 19107:2003, Figure 8 calls these association ends "containedPrimitive" and "containingPrimitive," respectively, although they are called "coincidentSubelement" and superElement" in the text of ISO 19107.

5.5.7 Contains

The multiplicity of the association roles "subComplex" and "superComplex" of GM_Complex (ISO 19107:2003, 6.6.2.3, association "Contains") is restricted on both ends to [0]. Thus, this International Standard excludes GM_Complexes which are coincident with one another.

```
GM_Complex::subComplex[0] : GM_Complex (multiplicity restricted from [0..n])
GM_Complex::superComplex[0] : GM_Complex (multiplicity restricted from [0..n])
```

5.5.8 Complex

The multiplicities of the association roles "element" and "complex" between GM_Primitive and GM_Complex (ISO 19107:2003, 6.6.2.4, association "Complex") are restricted to [0]. Thus, geometric primitives cannot be part of a complex as complexes exceed the minimal capabilities required by this International Standard.

```
GM_Primitive::complex[0] : GM_Complex (multiplicity restricted from [0..n])
```

5.5.9 Composition

The multiplicities of the association roles "generator" and "composite" between GM_Primitive and GM_Composite (ISO 19107:2003, Figure 25, association "Composition") are restricted to [0]. Thus, geometric primitive cannot be part of a composite as composites exceed the minimal capabilities required by this International Standard.

```
GM_Primitive::composite[0] : GM_Composite (multiplicity restricted from [0..n])
```

5.6   GM_Position

The data type GM_Position (ISO 19107:2003, 6.4.5) is restricted as follows: the multiplicity of its attribute "direct" is restricted to [1] and the multiplicity of its attribute "indirect" is restricted to [0]. Thus, the data type only allows the identification of a position as a coordinate (the direct variant). The indirect variant is not used.

```
GM_Position::direct[1] : DirectPosition (multiplicity restricted from [0,1])
GM_Position::indirect[0] : GM_PointRef (multiplicity restricted from [0,1])
```

5.7   GM_CurveSegment

The multiplicity of the attributes GM_CurveSegment::numDerivativesAtStart, numDerivativesInterior and numDerivativesAtEnd (ISO 19107:2003, 6.4.9.3) is restricted from [0,1] to [0]. Thus, only simple continuity within and between adjacent curve segments is described.

```
GM_CurveSegment::numDerivativesAtStart[0] : Integer (multiplicity restricted from [0,1])
GM_CurveSegment::numDerivativesInterior[0] : Integer (multiplicity restricted from [0,1])
GM_CurveSegment::numDerivativesAtEnd[0] : Integer (multiplicity restricted from [0,1])
```

5.8   GM_CurveInterpolation

The code list GM_CurveInterpolation (ISO 19107:2003, 6.4.8) is restricted to "linear". Thus, the interpolation between the points of a curve is restricted to straight lines, excluding all other interpolations, such as geodesic, elliptical, clothoid, etc.

5.9   GM_SurfaceInterpolation

The code list GM_SurfaceInterpolation (ISO 19107:2003, 6.4.32) is restricted to "planar" and "none". Thus, the interior of a surface is either a plane, or is not specified and hence is defined by the reference surface.

5.10 GM_SurfacePatch

The multiplicity of the attribute GM_SurfacePatch::numDerivativesOnBoundary (ISO 19107:2003, 6.4.34.3) is restricted from [0,1] to [0]. Thus, only simple continuity at the boundary between adjacent surfaces is described.

```
GM_SurfacePatch::numDerivativesOnBoundary[0] : Integer (multiplicity restricted from [0,1])
```