

DIN EN ISO 19136-1



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Ersatz für
DIN EN ISO 19136:2009-09

**Geoinformation –
Geography Markup Language (GML) –
Teil 1: Grundsätze (ISO 19136-1:2020);
Englische Fassung EN ISO 19136-1:2020, nur auf CD-ROM**

Geographic information –
Geography Markup Language (GML) –
Part 1: Fundamentals (ISO 19136-1:2020);
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Information géographique –
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Nationales Vorwort

Dieses Dokument (EN ISO 19136-1:2020) enthält unter Berücksichtigung des Präsidialbeschlusses 1/2004 den englischen Originaltext der Internationalen Norm ISO 19136-1:2020.

Dieses Dokument (EN ISO 19136-1:2020) wurde vom Technischen Komitee ISO/TC 211 „Geographic information/Geomatics“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 287 „Geoinformation“ übernommen, dessen Sekretariat von BSI (Vereinigtes Königreich) gehalten wird.

Der für die deutsche Mitarbeit zuständige Arbeitsausschuss im DIN Deutsches Institut für Normung e. V. ist der Arbeitsausschuss NA 005-03-03 AA „Geoinformation (SpA zu CEN/TC 287+ISO/TC 211)“ des Normenausschusses Bauwesen (NABau).

Die Geography Markup Language (GML) ist eine im XML-Schema beschriebene XML-Sprache für den Transport und die Speicherung von Geoinformationen, modelliert in Übereinstimmung mit den konzeptuellen Modellierungsgrundsätzen, die in der Normenreihe DIN EN ISO 19100 angewendet werden, einschließlich der raumbezogenen und nicht raumbezogenen Eigenschaften von Fachobjekten.

Ein Fachobjekt ist eine „Abstraktion von Phänomenen der realen Welt“ (siehe DIN EN ISO 19101). Eine digitale Repräsentation der realen Welt kann somit als Menge von Fachobjekten verstanden werden. Der Zustand eines Fachobjekts wird wiederum durch eine Menge von Eigenschaften beschrieben, wobei eine Eigenschaft als ein Tripel {Name, Typ, Wert} verstanden werden kann.

Die möglichen Eigenschaften eines Fachobjekts werden durch seine Typfestlegung bestimmt. Die Typfestlegungen sind nach DIN EN ISO 19109 in Anwendungsschemata beschrieben. Ein GML-Anwendungsschema ist als XML-Schema spezifiziert und kann auf zwei Arten erzeugt werden:

- auf der Basis eines UML-Anwendungsschemas entsprechend DIN EN ISO 19109 und unter Anwendung der in dieser Norm spezifizierten Bedingungen und Regeln;
- unmittelbar im XML-Schema unter Anwendung der in dieser Norm spezifizierten Bedingungen und Regeln.

GML spezifiziert standardisierte XML-Codierungen für häufig verwendete konzeptuelle Typen aus den folgenden Normen und Technischen Spezifikationen:

- ISO/TS 19103, *Geographic information — Conceptual schema language*;
- DIN EN ISO 19107, *Geoinformation — Raumbezugsschema (ISO 19107:2003)*;
- DIN EN ISO 19108, *Geoinformation — Zeitliches Schema (ISO 19108:2002)*;
- DIN EN ISO 19111, *Geoinformation — Koordinatenreferenzsysteme (ISO 19111:2007)*;
- DIN EN ISO 19123, *Geoinformation — Coverage Geometrie und Funktionsschema (ISO 19123:2005)*.

Darüber hinaus legt diese Norm standardisierte XML-Codierungen für weitere häufig in Anwendungsschemata verwendete, aber bislang noch nicht genormte, Konzepte (z. B. Fachobjekte mit dynamischen Eigenschaften) fest.

Die Festlegung von standardisierten XML-Codierungen zur Verwendung in GML-Anwendungsschemata ermöglicht einen anwendungsübergreifenden Austausch von Geoinformationen.

Auf der Basis dieser Festlegungen

- spezifiziert diese Norm ein offenes, herstellernerutrales System für die Beschreibung von raumbezogenen Anwendungsschemata für den Transport und die Speicherung von Geoinformationen in XML,
- unterstützt sie Profile, die geeignete Untermengen von in GML beschriebenen Eigenschaften unterstützen,
- unterstützt sie die Beschreibung von raumbezogenen Anwendungsschemata für spezialisierte Bereiche und Informationsgemeinschaften,
- ermöglicht sie die Erzeugung und Pflege von miteinander verbundenen raumbezogenen Anwendungsschemata und Datenbeständen,
- unterstützt sie die Speicherung und den Transport von Anwendungsschemata und Datenbeständen,
- erhöht sie die Fähigkeit von Organisationen, raumbezogene Anwendungsschemata und die Informationen, die sie beschreiben, auszutauschen.

Für die in diesem Dokument zitierten Dokumente wird im Folgenden auf die entsprechenden deutschen Dokumente hingewiesen:

ISO 19101:2002	siehe	DIN EN ISO 19101:2005-05
ISO 19105	siehe	DIN EN ISO 19105
ISO 19106:2004	siehe	DIN EN ISO 19106:2006-05
ISO 19107:2003	siehe	DIN EN ISO 19107:2005-05
ISO 19108:2002	siehe	DIN EN ISO 19108:2005-05
ISO 19109:2005	siehe	DIN EN ISO 19109:2006-09
ISO 19109:2015	siehe	DIN EN ISO 19109:2016-05
ISO 19110:2005	siehe	DIN EN ISO 19110:2006-09
ISO 19115:2003	siehe	DIN EN ISO 19115:2005-05
ISO 19117	siehe	DIN EN ISO 19117
ISO 19118:2005	siehe	DIN EN ISO 19118:2006-09
ISO 19118:2011	siehe	DIN EN ISO 19118:2012-01
ISO 19123:2005	siehe	DIN EN ISO 19123:2007-06
ISO 19133	siehe	DIN EN ISO 19133
ISO 19137:2007	siehe	DIN EN ISO 19137:2008-09
ISO 19141	siehe	DIN EN ISO 19141
ISO 80000-3	siehe	DIN EN ISO 80000-3

Aktuelle Informationen zu diesem Dokument können über die Internetseiten von DIN (www.din.de) durch eine Suche nach der Dokumentennummer aufgerufen werden.

Änderungen

Gegenüber DIN EN ISO 19136:2009-09 wurden folgende Änderungen vorgenommen:

- a) das XML-Attribut `gml:id` in `gml:AbstractGMLType` ist nun optional;
- b) die XML-Elemente `gml:AbstractRing` bzw. `gml:Shell` wurden den `substitutionGroups` `gml:AbstractCurve` bzw. `gml:AbstractSurface` hinzugefügt;
- c) die XML-Typen `gml:AbstractRingType` bzw. `gml:ShellType` erweitern nun die Basistypen `gml:AbstractCurveType` bzw. `gml:AbstractSurfaceType`.

Diese Änderungen beheben Inkonsistenzen mit ISO 19107, ohne bestehende GML-Dokumente invalide zu machen, d. h. alle validen GML-3.2-Dokumente, die nach der Version GML 3.2.1 erzeugt wurden, sind auch gegenüber der Version 3.2.2 valide.

Die Änderung am gml:id-Attribut macht eine frühere Änderung zwischen den GML-Versionen GML 3.1.1 und GML 3.2.1 auf Wunsch verschiedener Nutzergruppen wieder rückgängig. Da diese Änderung die Anforderungen lockert, sind nicht alle GML-Dokumente, die nach GML 3.2.2 erzeugt wurden, valide gegenüber dem GML-3.2.1-Schema. Sofern vorhanden, sollten lokale Kopien des GML-3.2.1-Schemas daher auf das GML-3.2.2-Schema aktualisiert werden.

Außerdem aktualisiert diese Version verschiedene URIs, hauptsächlich in Beispielen, wo sich seit der Veröffentlichung von GML 3.2.1 in 2007 die OGC-Policies für globale Identifikatoren geändert haben.

Frühere Ausgaben

DIN EN ISO 19136:2009-09

Nationaler Anhang NA (informativ)

Begriffe

Die Benennungen der folgenden Begriffe entsprechen den Benennungen in der Englischen Fassung.

3 Begriffe, Symbole und Abkürzungen

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>
- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>

3.1.1

Anwendungsschema

konzeptuelles *Schema* (3.1.52) für Daten, die in einer oder mehreren Anwendungen erforderlich sind

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

3.1.2

Assoziation

<UML> semantische Beziehung zwischen typisierten Instanzen

[QUELLE: ISO 19103:2015, 4.4, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht]

3.1.3

Attribut

<XML> in einem *Element* (3.1.23) enthaltenes Paar aus Namen und Werten

Anmerkung 1 zum Begriff: In diesem Dokument ist ein Attribut ein XML-Attribut, sofern nicht anders festgelegt. Die Syntax eines XML-Attributs ist „Attribute::= Name = AttValue“. Ein Attribut agiert üblicherweise als Modifikator eines XML-Elements (z. B. <Road gml:id = “r1” />; in diesem Fall ist gml:id ein Attribut).

3.1.4

Grenze

eine Menge, die die Begrenzung einer Entität darstellt

[QUELLE: ISO 19107:2019, 3.6, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht]

3.1.5

Kindelement

<XML> direkt nachfolgendes *Element* eines *Elements* (3.1.23)

3.1.6

Abschluss

Vereinigung des *Inneren* (3.1.39) und der *Grenze* (3.1.4) eines *Topologie-* (3.1.59) oder *Geometrieobjekts* (3.1.30)

[QUELLE: ISO 19107:2019, 3.8]

3.1.7

Codeliste

Wertebereich, einschließlich eines Codes für jeden zulässigen Wert

3.1.8

Namensraum

Regel oder Quelle für einen Code, einen Namen, einen Begriff oder eine Kategorie

BEISPIEL Wörterbücher, Quellen, Codelisten usw.

3.1.9

zusammengesetzte Kurve

Sequenz von *Kurven* (3.1.17), so dass jede Kurve (abgesehen von der ersten) am Endpunkt der vorherigen Kurve der Folge beginnt

Anmerkung 1 zum Begriff: Eine zusammengesetzte Kurve hat als Menge direkter Positionen alle Eigenschaften einer Kurve.

3.1.10

zusammengesetzter Körper

verbundene Menge von Körpern, die entlang gemeinsamer *Grenzoberflächen* (3.1.4) aneinander liegen

Anmerkung 1 zum Begriff: Ein zusammengesetzter Körper hat als Menge direkter Positionen alle Eigenschaften eines Körpers.

3.1.11

zusammengesetzte Oberfläche

verbundene Menge von *Oberflächen* (3.1.57), die entlang gemeinsamer *Grenzkurven* (3.1.4) aneinander liegen

Anmerkung 1 zum Begriff: Eine zusammengesetzte Oberfläche hat als Menge direkter Positionen alle Eigenschaften einer Oberfläche.

3.1.12

Koordinate

eine der Sequenzen von Nummern, die die Position eines Punkts (3.1.47) bezeichnen

Anmerkung 1 zum Begriff: In einem raumbezogenen Koordinatenreferenzsystem werden die Koordinatennummern durch Einheiten qualifiziert.

[QUELLE: ISO 19111:2019, 3.1.5]

3.1.13

Koordinatenreferenzsystem

Koordinatensystem (3.1.14), das über ein *Datum* (3.1.19) mit einem Objekt verbunden ist

[QUELLE: ISO 19111:2019, 3.1.9, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht.]

3.1.14**Koordinatensystem**

Menge mathematischer Regeln zur Festlegung, wie *Koordinaten* (3.1.12) *Punkten* (3.1.47) zugewiesen werden sollen

[QUELLE: ISO 19111:2019, 3.1.11]

3.1.15**Koordinatentupel**

Tupel (3.1.60) bestehend aus *Koordinaten* (3.1.12)

[QUELLE: ISO 19111:2019, 3.1.13, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht.]

3.1.16**Coverage**

Feature (3.1.26), das als *Funktion* (3.1.28) zur Rückgabe von Werten aus seinem *Wertebereich* (3.1.50) für jede *direkte Position* (3.1.20) innerhalb seines räumlichen, zeitlichen oder raumzeitlichen *Bereichs* (3.1.21) agiert

[QUELLE: ISO 19123:2005, 4.1.7, modifiziert — Beispiel und Anmerkung wurden gelöscht.]

3.1.17**Kurve**

1-dimensionales *geometrisches Primitiv* (3.1.31), das das kontinuierliche Bild einer Linie darstellt

Anmerkung 1 zum Begriff: Die Grenze einer Kurve ist die Menge der Punkte an beiden Enden der Kurve. Falls es sich bei der Kurve um einen Kreis handelt, sind die beiden Enden identisch, und es wird angenommen, dass die Kurve (wenn sie topologisch geschlossen ist) keine Grenze aufweist. Der erste Punkt wird als Startpunkt und der letzte Punkt als Endpunkt bezeichnet. Die Konnektivität der Kurve wird durch den Abschnitt „kontinuierliches Bild einer Linie“ sichergestellt. Ein topologisches Theorem besagt, dass ein kontinuierliches Bild einer verbundenen Menge verbunden ist.

3.1.18**Datentyp**

Spezifikation eines *Wertebereichs* (3.1.21), bei der Operationen mit Werten in diesem Bereich gestattet sind

BEISPIEL ganzzahlig, echt, Boolesch, String, Datum (Konvertierung von Daten in eine Reihe von Codes).

Anmerkung 1 zum Begriff: Datentypen umfassen primitive vordefinierte Typen und vom Benutzer definierbare Typen. Allen Instanzen eines Datentyps fehlt Identität.

[QUELLE: ISO 19103:2015, 4.1.4, modifiziert — Zusätzliche Informationen wurden zum Beispiel und zur Anmerkung 1 zum Begriff hinzugefügt.]

3.1.19**Datum**

Parameter oder Menge von Parametern, der/die die Position der Herkunft, des Maßstabs und der Ausrichtung eines *Koordinatensystems* (3.1.14) realisiert/realisieren

[QUELLE: ISO 19111:2019, 3.1.15]

3.1.20

direkte Position

durch eine einzelne Menge von *Koordinaten* (3.1.12) beschriebene Position innerhalb eines *Koordinatenreferenzsystems* (3.1.13)

3.1.21

Bereich

klar definierte Menge

Anmerkung 1 zum Begriff: Eine mathematische *Funktion* (3.1.28) kann in dieser Menge definiert werden, d. h. in einer Funktion $f:A \rightarrow B$, ist A der Bereich der Funktion f.

Anmerkung 2 zum Begriff: Ein Bereich, wie in Diskursbereich, bezieht sich auf ein Thema oder einen Interessensbereich.

[QUELLE: ISO 19109:2015, 4.8]

3.1.22

Kante

<Topologie> 1-dimensionales topologisches Primitiv

Anmerkung 1 zum Begriff: Die geometrische Realisierung einer Kante ist eine Kurve. Die Grenze einer Kante ist die Menge von einem oder zwei Knoten, die mit einer Kante in einem topologischen Komplex assoziiert sind.

[QUELLE: ISO 19107:2019, 3.29]

3.1.23

Element

<XML> grundlegendes Informationselement eines XML-Dokuments, das *Kindelemente* (3.1.5), *Attribute* (3.1.3) und Zeichendaten enthält

Anmerkung 1 zum Begriff: „The Extensible Markup Language (XML) 1.0 (Fifth Edition)“, Abschnitt 3 verwendet folgende Definition: „Jedes XML-Dokument enthält ein oder mehrere Elemente, deren Grenzen entweder durch Start- und End-Tags oder, bei leeren Elementen, durch ein Leeres-Element-Tag bestimmt werden. Jedes Element weist einen durch einen Namen identifizierten Typen auf, der manchmal als dessen „generischer Identifikator“ (GI) bezeichnet wird, und kann eine Menge von Attributspezifikationen umfassen. Jede Attributspezifikation verfügt über einen Namen und einen Wert.“

3.1.24

Äußeres

<Geometrie, Topologie> Unterschied zwischen dem Universum und dem *Abschluss* (3.1.6)

Anmerkung 1 zum Begriff: Der Begriff des Äußeren ist sowohl auf das Topologieobjekt als auch auf das Geometrieobjekt anwendbar.

[QUELLE: ISO 19107:2019, 3.37]

3.1.25

Masche

<Topologie> 2-dimensionales topologisches Primitiv

Anmerkung 1 zum Begriff: Die geometrische Realisierung einer Masche ist die Oberfläche. Die Grenze einer Masche ist die Menge der gerichteten Kanten innerhalb desselben Topologiekomplexes, die über Grenzbeziehungen mit der Masche zusammenhängen. Diese können in Form von Ringen organisiert sein.

[QUELLE: ISO 19107:2019, 3.38]

3.1.26**Feature**

Abstraktion eines Phänomens der realen Welt

Anmerkung 1 zum Begriff: Ein Feature kann als Typ oder Instanz auftreten. „Feature-Klasse“ oder „Feature-Instanz“ wird verwendet, wenn nur eines gemeint ist.

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

3.1.27**Feature-Assoziation**

Beziehung, die Instanzen einer *Feature*-Klasse (3.1.26) mit Instanzen derselben oder einer anderen Feature-Klasse verbindet

[QUELLE: ISO 19110:2016, 3.3]

3.1.28**Funktion**

<Mathematik, Programmieren> Regel, die jedes Element (3.1.23) eines *Bereiches* (3.1.21) („Quelle“ oder „Bereich der Funktion“) mit einem einzigartigen Element eines anderen Bereiches („Ziel“, „Co-Bereich“ oder „Wertebereich“ (3.1.50) der Funktion) verbindet

[QUELLE: ISO 19107:2019, 3.41]

3.1.29**geodätisches Datum**

Datum (3.1.19), das die Beziehung eines 2- oder 3-dimensionalen *Koordinatensystems* (3.1.14) zur Erde beschreibt

[QUELLE: ISO 19111:2019, 4.24]

3.1.30**Geometrieobjekt**

<Geometrie> *raumbezogenes Objekt* (3.1.56), das eine *geometrische Menge* (3.1.32) darstellt

[QUELLE: ISO 19107:209, 3.49, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht.]

3.1.31**geometrisches Primitiv**

<Geometrie> *Geometrieobjekt* (3.1.30), das ein einzelnes, verbundenes, homogenes (isotrop) Raumelement darstellt

[QUELLE: ISO 19107:2019, 3.50, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht.]

3.1.32**geometrische Menge**

Menge *direkter Positionen* (3.1.20)

Anmerkung 1 zum Begriff: Diese Definition stammt eher aus der Definition in ISO 19107:2003 als in ISO 19107:2019, da letztere den Begriff „Punkt“ mit einer breiteren Bedeutung als in diesem Dokument verwendet.

[QUELLE: ISO 19107:2003, 4.50]

3.1.33

Geometrieeigenschaft

<GML> *Eigenschaft* (3.1.49) eines *GML-Features* (3.1.26), die einen Aspekt der Geometrie des Features beschreibt

Anmerkung 1 zum Begriff: Der Name des Geometrieobjekts ist die Rolle der Geometrie in Bezug auf das Feature.

3.1.34

GML-Anwendungsschema

Anwendungsschema (3.1.1), das in Übereinstimmung mit den in diesem Dokument festgelegten Regeln im XML-Schema geschrieben wurde

3.1.35

GML-Dokument

XML-Dokument mit einem Hauptelement, das zu einem der im *GML-Schema* (3.1.37) festgelegten Elemente *AbstractFeature*, *Dictionary* oder *TopoComplex* oder zu jedem Element einer Substitutionsgruppe jedes dieser Elemente gehört

3.1.36

GML-Profil

Teilmenge des *GML-Schema* (3.1.37)

3.1.37

GML-Schema

Schemakomponenten (3.1.52) im *XML-Namensraum* (3.1.43) „<http://www.opengis.net/gml/3.2>“, wie in diesem Dokument festgelegt

3.1.38

Gitter

Netzwerk bestehend aus zwei oder mehr Mengen von *Kurven* (3.1.17), in dem die Teile jeder Menge die Teile anderen Mengen algorithmisch kreuzen

Anmerkung 1 zum Begriff: Die Kurven unterteilen einen Raum in Gitterzellen.

[QUELLE: ISO 19123:2005, 4.1.23]

3.1.39

Inneres

Menge aller *direkten Positionen* (3.1.20), die sich auf einem *Geometrieobjekt* (3.1.30), jedoch nicht auf seiner *Grenze* (3.1.4) befinden

3.1.40

Linienfolge

Kurve (3.1.37) bestehend aus Segmenten gerader Linien

3.1.41

Maß

<GML> Wert, der mittels eines Zahlenwerts mit einem Maßstab oder mit einem skalaren Referenzsystem beschrieben wird

Anmerkung 1 zum Begriff: Bei der Anwendung als Substantiv ist Maß ein Synonym für eine physikalische Größe.

3.1.42

Messgröße

bestimmte Größe, die Gegenstand einer Messung ist

[QUELLE: VIM:1993, 2.6]

3.1.43

Namensraum

<XML> Sammlung von Namen, die durch einen *URI*-Verweis (3.1.62) identifiziert und in XML-Dokumenten als Element- und Attributnamen verwendet werden (W3C-XML-Namensräume)

3.1.44

Knoten

<Topologie> 0-dimensionales topologisches Primitiv

Anmerkung 1 zum Begriff: Die Grenze eines Knoten ist die leere Menge.

[QUELLE: ISO 19107:2019, 3.69]

3.1.45

beobachtbarer Typ

Datentyp (3.1.18) zur Anzeige der *physikalischen Größe* (3.1.46) als Ergebnis einer Beobachtung

3.1.46

physikalische Größe

Größe, die für die quantitative Beschreibung physikalischer Phänomene verwendet wird

Anmerkung 1 zum Begriff: In GML ist eine physikalische Größe stets ein Wert, der mittels eines Zahlenwerts mit einem Maßstab oder mit einem skalaren Referenzsystem beschrieben wird. Die physikalische Größe ist ein Synonym für Maß, wenn diese als Substantiv verwendet wird.

3.1.47

Punkt

0-dimensionales *geometrisches Primitiv* (3.1.31), das eine Position darstellt

Anmerkung 1 zum Begriff: Die Grenze eines Punkts ist die leere Menge.

3.1.48

Polygon

planare *Oberfläche* (3.1.57) definiert durch 1 *äußere* (3.1.24) *Grenze* (3.1.4) und 0 oder mehr *innere* (3.1.39) *Grenzen* (3.1.4)

3.1.49

Eigenschaft

<GML> ein *Kindelement* (3.1.5) eines GML-Objekts

Anmerkung 1 zum Begriff: Sie entspricht der Feature-Attribut- und Feature-Assoziations-Rolle in ISO 19109. Falls eine GML-Eigenschaft eines Features ein *xlink:href*-Attribut aufweist, das auf ein Feature verweist, stellt die Eigenschaft eine Feature-Assoziations-Rolle dar.

3.1.50

Wertebereich

Co-Bereich

<Mathematik> akzeptable Zielwerte einer *Funktion* (3.1.28)

[QUELLE: ISO 19107:2019, 3.80]

3.1.51

gerichtetes Gitter

Gitter (3.1.38), für welches eine Affintransformation zwischen den Gitterkoordinaten und den *Koordinaten* (3.1.12) eines externen *Koordinatenreferenzsystems* (3.1.13) vorliegt

[QUELLE: ISO 19123:2005, 4.1.32, modifiziert — Die ANMERKUNG wurde gelöscht.]

3.1.52

Schema

formelle Beschreibung eines Modells

Anmerkung 1 zum Begriff: Im Allgemeinen ist ein Schema eine abstrakte Darstellung der Merkmale eines Objekts und seiner Beziehung zu anderen Objekten. Ein XML-Schema stellt die Beziehung zwischen den Attributen und Elementen eines XML-Objekts dar

BEISPIEL ein Dokument oder ein Teil eines Dokuments.

[QUELLE: ISO 19101-1:2014, 4.1.34, modifiziert — Anmerkung 1 zum Begriff und BEISPIEL wurden hinzugefügt.]

3.1.53

Schema

<XML-Schema> Sammlung von *Schemakomponenten* (3.1.52) innerhalb desselben *Zielnamensraums* (3.1.43)

BEISPIEL Schemakomponenten des W3C-XML-Schemas sind Typen, Elemente, Attribute, Gruppen usw.

3.1.54

Schemadokument

<XML-Schema> XML-Dokument, das Definitionen und Erklärungen zu *Schemakomponenten* (3.1.52) enthält

Anmerkung 1 zum Begriff: Das W3C XML-Schema liefert ein XML-Austauschformat für Schemainformationen. Ein einzelnes Schemadokument enthält Beschreibungen von Komponenten, die mit einem einzelnen XML-Namensraum zusammenhängen, aber mehrere Dokumente können Komponenten im selben Schema beschreiben, d. h. im selben Zielnamensraum.

3.1.55

semantischer Typ

Kategorie von Objekten, die einige allgemeine Merkmale miteinander teilen und somit mit einem identifizierenden Typnamen in einem bestimmten Diskursbereich versehen werden

3.1.56

raumbezogenes Objekt

<Topologie, Geometrieobjekt> Objekt, das zur Darstellung der raumbezogenen Merkmale eines *Features* (3.1.26) verwendet wird

[QUELLE: ISO 19107:2019, 3.87]

3.1.57

Oberfläche

2-dimensionales *geometrisches Primitiv* (3.1.31), das ein kontinuierliches Bild einer Region einer Ebene darstellt

Anmerkung 1 zum Begriff: Die Grenze einer Oberfläche ist die Menge der gerichteten, geschlossenen Kurven, die die Begrenzungen der Oberfläche beschreiben. Oberflächen, die sich gegenüber Kugeln oder einem n-Torus (eine topologische Kugel mit n „Griffen“) isomorph verhalten, haben keine Grenze. Derartige Oberflächen werden als Zyklen bezeichnet.

3.1.58

Tag

<XML> Markup in einem XML-Dokument, das den Inhalt eines *Elements* (3.1.23) begrenzt

BEISPIEL <Road>

Anmerkung 1 zum Begriff: Ein Tag ohne Schrägstrich (z. B. <Road>) wird als Start-Tag (oder auch öffnendes Tag) und ein Tag mit Schrägstrich (z. B. </Road>) wird als End-Tag (oder auch schließendes Tag) bezeichnet.

3.1.59

topologisches Objekt

raumbezogenes Objekt (3.1.56), das die räumlichen Merkmale darstellt, die unter kontinuierlichen Transformationen invariant sind

[QUELLE: ISO 19107:2019, 3.99, modifiziert — Anmerkung 1 zum Begriff wurde gelöscht.]

3.1.60

Tupel

geordnete Liste von Werten

Anmerkung 1 zum Begriff: Die Anzahl der Werte in einem Tupel ist unveränderlich.

3.1.61

UML-Anwendungsschema

in Übereinstimmung mit ISO 19109 in UML geschriebenes *Anwendungsschema* (3.1.1)

3.1.62

Uniform Resource Identifier (URI)

einzigartiger Identifikator für eine Ressource, der in Übereinstimmung mit IETF RFC 2396 strukturiert wird

Anmerkung 1 zum Begriff: Die generelle Syntax ist <scheme>::<scheme-specific-part>. Die hierarchische Syntax mit einem Namensraum ist <scheme>://<authority><path>?<query> — siehe RFC 2396.

3.2 Abkürzungen

CRS Coordinate Reference System, de: Koordinatenreferenzsystem

CS Coordinate System, de: Koordinatensystem

CSV Comma Separated Values

CT Coordinate Transformation, de: Koordinatentransformation

DTD Document Type Definition

EPSG European Petroleum Survey Group

GIS Geographic Information System, de: Geographisches Informationssystem

GML Geography Markup Language

NOTE The abbreviated term GML was previously used also as Generalized Markup Language (which led to SGML, Standard Generalized Markup Language, ISO 8879).

HTTP Hypertext Transfer Protocol

IETF Internet Engineering Task Force

ISO International Organization for Standardization

OGC Open Geospatial Consortium

RDF	Resource Description Framework
RFC	Request for Comments
SMIL	Synchronized Multimedia Integration Language
SOAP	Simple Object Access Protocol
SVG	Scalable Vector Graphics
UML	Unified Modeling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
W3C	World Wide Web Consortium
WFS	Web Feature Service
XML	eXtensible Markup Language
XSLT	eXtensible Stylesheet Language — Transformations
0D	zero-dimensional
1D	one-dimensional
2D	two-dimensional
3D	three-dimensional

Nationaler Anhang NB (informativ)

Englisch-deutsche Fachwörterliste

application schema	Anwendungsschema
association	Beziehung, Relation, Assoziation
attribute	Attribut
boundary	Grenze
child element	Kindelement
closure	Abschluss
codelist	Codeliste
codespace, namespace	Namensraum
coordinate	Koordinate
coordinate reference system	Koordinatenreferenzsystem
coordinate system	Koordinatensystem
coverage	Coverage
curve	Kurve, Linie
data type	Datentyp
datum	Datum
direct position	Position
domain	Bereich
edge	Kante
element	Element
face	Masche
feature	Feature
function	Funktion
geodetic datum	geodätisches Datum
geometric object	Geometrieobjekt
geometric primitive	geometrisches Primitiv
geometry property	Geometrieeigenschaft
GML application schema	GML-Anwendungsschema
GML document	GML-Dokument
GML profile	GML-Profil
GML schema	GML-Schema
grid	Gitter
node	Knoten
object	Objekt
point	Punkt
property	Eigenschaft
schema	Schema
schema document	Schemadokument
sequence	Sequenz
set	Menge
spatial object	raumbezogenes Objekt
surface	Fläche
tag	Tag
topological object	topologisches Objekt
tuple	Tupel
UML application schema	UML-Anwendungsschema
Uniform Resource Identifier (URI)	Uniform Resource Identifier (URI)

Nationaler Anhang NC (informativ)

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European foreword

This document (EN ISO 19136-1:2020) has been prepared by Technical Committee ISO/TC 211 "Geographic information/Geomatics" in collaboration with Technical Committee CEN/TC 287 "Geographic Information" the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2020, and conflicting national standards shall be withdrawn at the latest by October 2020.

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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).

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.

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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 (Fifth 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)

3.1.6

closure

union of the *interior* (3.1.39) and *boundary* (3.1.4) of a *topological object* (3.1.59) or *geometric object* (3.1.30)

[SOURCE: ISO 19107:2019, 3.8]

3.1.7

codelist

value domain including a code for each permissible value

3.1.8

codespace

rule or authority for a code, name, term or category

EXAMPLE Dictionaries, authorities, codelists, etc.

3.1.9

composite curve

sequence of *curves* (3.1.17) such that each curve (except the first) starts at the end point of the previous curve in the sequence

Note 1 to entry: A composite curve, as a set of direct positions, has all the properties of a curve.

3.1.10

composite solid

connected set of solids adjoining one another along shared *boundary* (3.1.4) surfaces

Note 1 to entry: A composite solid, as a set of direct positions, has all the properties of a solid.

3.1.11

composite surface

connected set of *surfaces* (3.1.57) adjoining one another along shared *boundary* (3.1.4) curves

Note 1 to entry: A composite surface, as a set of direct positions, has all the properties of a surface.

3.1.12

coordinate

one of a sequence of numbers designating the position of a *point* (3.1.47)

Note 1 to entry: In a spatial coordinate reference system, the coordinate numbers are qualified by units.

[SOURCE: ISO 19111:2019, 3.1.5]

3.1.13

coordinate reference system

coordinate system (3.1.14) that is related to an object by a *datum* (3.1.19)

[SOURCE: ISO 19111:2019, 3.1.9, modified — Note 1 to entry has been deleted.]

3.1.14

coordinate system

set of mathematical rules for specifying how *coordinates* (3.1.12) are to be assigned to *points* (3.1.47)

[SOURCE: ISO 19111:2019, 3.1.11]

3.1.15

coordinate tuple

tuple (3.1.60) composed of *coordinates* (3.1.12)

[SOURCE: ISO 19111:2019, 3.1.13, modified — Note 1 to entry has been deleted.]

3.1.16 coverage

feature (3.1.26) that acts as a *function* (3.1.28) to return values from its *range* (3.1.50) for any *direct position* (3.1.20) within its spatial, temporal or spatiotemporal *domain* (3.1.21)

[SOURCE: ISO 19123:2005, 4.1.7, modified — Example and Note to entry have been deleted.]

3.1.17 curve

1-dimensional *geometric primitive* (3.1.31), representing the continuous image of a line

Note 1 to entry: The boundary of a curve is the set of points at either end of the curve. If the curve is a cycle, the two ends are identical, and the curve (if topologically closed) is considered to not have a boundary. The first point is called the start point, and the last is the end point. Connectivity of the curve is guaranteed by the “continuous image of a line” clause. A topological theorem states that a continuous image of a connected set is connected.

3.1.18 data type

specification of a value *domain* (3.1.21) with operations allowed on values in this domain

EXAMPLE Integer, Real, Boolean, String, Date (conversion of data into a series of codes).

Note 1 to entry: Data types include primitive predefined types and user-definable types. All instances of a data type lack identity.

[SOURCE: ISO 19103:2015, 4.14, modified — Supplementary information has been added to Example and Note 1 to entry.]

3.1.19 datum

parameter or set of parameters that realize the position of the origin, the scale, and the orientation of a *coordinate system* (3.1.14)

[SOURCE: ISO 19111:2019, 3.1.15]

3.1.20 direct position

position described by a single set of *coordinates* (3.1.12) within a *coordinate reference system* (3.1.13)

3.1.21 domain

well-defined set

Note 1 to entry: A mathematical *function* (3.1.28) may be defined on this set, i.e. in a function $f:A \rightarrow B$, A is the domain of the function f .

Note 2 to entry: A domain as in domain of discourse refers to a subject or area of interest.

[SOURCE: ISO 19109:2015, 4.8]

3.1.22 edge

<topology> 1-dimensional topological primitive

Note 1 to entry: The geometric realization of an edge is a curve. The boundary of an edge is the set of one or two nodes associated with the edge within a topological complex.

[SOURCE: ISO 19107:2019, 3.29]

3.1.23 element

<XML> basic information item of an XML document containing *child elements* (3.1.5), *attributes* (3.1.3) and character data

Note 1 to entry: The Extensible Markup Language (XML) 1.0 (Fifth Edition), Clause 3, uses the following definition: "Each XML document contains one or more elements, the boundaries of which are either delimited by start-tags and end-tags, or, for empty elements, by an empty-element tag. Each element has a type, identified by name, sometimes called its 'generic identifier' (GI), and may have a set of attribute specifications. Each attribute specification has a name and a value."

3.1.24 exterior

<geometry, topology> difference between the universe and the *closure* (3.1.6)

Note 1 to entry: The concept of exterior is applicable to both topological object and geometric object.

[SOURCE: ISO 19107:2019, 3.37]

3.1.25 face

<topology> 2-dimensional topological primitive

Note 1 to entry: The geometric realization of a face is a surface. The boundary of a face is the set of directed edges within the same topology complex that are associated with the face via the boundary relations. These can be organized as rings.

[SOURCE: ISO 19107:2019, 3.38]

3.1.26 feature

abstraction of real world phenomena

Note 1 to entry: A feature may occur as a type or an instance. Feature type or feature instance will be used when only one is meant.

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

3.1.27 feature association

relationship that links instances of one *feature* (3.1.26) type with instances of the same or a different feature type

[SOURCE: ISO 19110:2016, 3.3]

3.1.28 function

<mathematics, programming> rule that associates each *element* (3.1.23) from a *domain* (3.1.21) ("source domain," or "domain" of the function) to a unique element in another domain ("target domain," "co-domain," or "*range*" (3.1.50) of the function)

[SOURCE: ISO 19107:2019, 3.41]

3.1.29 geodetic datum

datum (3.1.19) describing the relationship of a 2- or 3-dimensional *coordinate system* (3.1.14) to the Earth

[SOURCE: ISO 19111:2007, 4.24]

3.1.30

geometric object

<geometry> *spatial object* (3.1.56) representing a *geometric set* (3.1.32)

[SOURCE: ISO 19107:2019, 3.49, modified — Note 1 to entry has been deleted.]

3.1.31

geometric primitive

<geometry> *geometric object* (3.1.30) representing a single, connected, homogeneous (isotropic) element of space

[SOURCE: ISO 19107:2019, 3.50, modified — Note 1 to entry has been deleted.]

3.1.32

geometric set

set of *direct positions* (3.1.20)

Note 1 to entry: This definition is taken from the definition in ISO 19107:2003 rather than ISO 19107:2019 since the 2019 version uses the term "point" with a broader meaning than in this document.

[SOURCE: ISO 19107:2003, 4.50]

3.1.33

geometry property

<GML> *property* (3.1.49) of a *GML feature* (3.1.26) that describes some aspect of the geometry of the feature

Note 1 to entry: The geometry property name is the role of the geometry in relation to the feature.

3.1.34

GML application schema

application schema (3.1.1) written in XML Schema in accordance with the rules specified in this document

3.1.35

GML document

XML document with a root element that is one of the elements *AbstractFeature*, *Dictionary* or *TopoComplex* specified in the *GML schema* (3.1.37) or any element of a substitution group of any of these elements

3.1.36

GML profile

subset of the *GML schema* (3.1.37)

3.1.37

GML schema

schema (3.1.52) components in the *XML namespace* (3.1.43) "http://www.opengis.net/gml/3.2" as specified in this document

3.1.38

grid

network composed of two or more sets of *curves* (3.1.17) in which the members of each set intersect the members of the other sets in an algorithmic way

Note 1 to entry: The curves partition a space into grid cells.

[SOURCE: ISO 19123:2005, 4.1.23]

3.1.39

interior

set of all *direct positions* (3.1.20) that are on a *geometric object* (3.1.30) but which are not on its *boundary* (3.1.4)

3.1.40

line string

curve (3.1.17) composed of straight-line segments

3.1.41

measure

<GML> value described using a numeric amount with a scale or using a scalar reference system

Note 1 to entry: When used as a noun, measure is a synonym for physical quantity.

3.1.42

measurand

particular quantity subject to measurement

[SOURCE: VIM:1993, 2.6]

3.1.43

namespace

<XML> collection of names, identified by a *URI* (3.1.62) reference, which are used in XML documents as element names and attribute names (W3C XML Namespaces)

3.1.44

node

<topology> 0-dimensional topological primitive

Note 1 to entry: The boundary of a node is the empty set.

[SOURCE: ISO 19107:2019, 3.69]

3.1.45

observable type

data type (3.1.18) to indicate the *physical quantity* (3.1.46) as a result of an observation

3.1.46

physical quantity

quantity used for the quantitative description of physical phenomena

Note 1 to entry: In GML, a physical quantity is always a value described using a numeric amount with a scale or using a scalar reference system. Physical quantity is a synonym for measure when the latter is used as a noun.

3.1.47

point

0-dimensional *geometric primitive* (3.1.31), representing a position

Note 1 to entry: The boundary of a point is the empty set.

3.1.48

polygon

planar *surface* (3.1.57) defined by 1 *exterior* (3.1.24) *boundary* (3.1.4) and 0 or more *interior* (3.1.39) *boundaries* (3.1.4)

3.1.49

property

<GML> *child element* (3.1.5) of a GML object

Note 1 to entry: It corresponds to feature attribute and feature association role in ISO 19109. If a GML property of a feature has an *xlink:href* attribute that references a feature, the property represents a feature association role.

3.1.50

range

co-domain

<mathematics> acceptable target values of a *function* (3.1.28)

[SOURCE: ISO 19107:2019, 3.80]

3.1.51

rectified grid

grid (3.1.38) for which there is an affine transformation between the grid coordinates and the *coordinates* (3.1.12) of an external *coordinate reference system* (3.1.13)

[SOURCE: ISO 19123:2005, 4.1.32, modified — The NOTE has been deleted.]

3.1.52

schema

formal description of a model

Note 1 to entry: In general, a schema is an abstract representation of an object's characteristics and relationship to other objects. An XML schema represents the relationship between the attributes and elements of an XML object.

EXAMPLE A document or a portion of a document.

[SOURCE: ISO 19101-1:2014, 4.1.34, modified — Note 1 to entry and EXAMPLE have been added.]

3.1.53

schema

<XML> collection of *schema* (3.1.52) components within the same target *namespace* (3.1.43)

EXAMPLE Schema components of W3C XML Schema are types, elements, attributes, groups, etc.

3.1.54

schema document

<XML> XML document containing *schema* (3.1.52) component definitions and declarations

Note 1 to entry: The W3C XML Schema provides an XML interchange format for schema information. A single schema document provides descriptions of components associated with a single XML namespace, but several documents may describe components in the same schema, i.e. the same target namespace.

3.1.55

semantic type

category of objects that share some common characteristics and are thus given an identifying type name in a particular domain of discourse

3.1.56

spatial object

<topology, geometry> object used for representing a spatial characteristic of a *feature* (3.1.26)

[SOURCE: ISO 19107:2019, 3.87]

3.1.57

surface

2-dimensional *geometric primitive* (3.1.31), locally representing a continuous image of a region of a plane

Note 1 to entry: The boundary of a surface is the set of oriented, closed curves that delineate the limits of the surface. Surfaces that are isomorphic to a sphere, or to an *n*-torus (a topological sphere with *n* "handles") have no boundary. Such surfaces are called cycles.

3.1.58

tag

<XML> markup in an XML document delimiting the content of an *element* (3.1.23)

EXAMPLE <Road>

Note 1 to entry: A tag with no forward slash (e.g. <Road>) is called a start-tag (also opening tag), and one with a forward slash (e.g. </Road> is called an end-tag (also closing tag).

3.1.59

topological object

spatial object (3.1.56) representing spatial characteristics that are invariant under continuous transformations

[SOURCE: ISO 19107:2019, 3.99, modified — Note 1 to entry has been deleted.]

3.1.60

tuple

ordered list of values

Note 1 to entry: The number of values in a tuple is immutable.

3.1.61

UML application schema

application schema (3.1.1) written in UML in accordance with ISO 19109

3.1.62

Uniform Resource Identifier

URI

unique identifier for a resource, structured in conformance with IETF RFC 2396

Note 1 to entry: The general syntax is <scheme>::<scheme-specific-part>. The hierarchical syntax with a namespace is <scheme>://<authority><path>?<query> — see RFC 2396.

3.2 Abbreviated terms

CRS	Coordinate Reference System
CS	Coordinate System
CSV	Comma Separated Values
CT	Coordinate Transformation
DTD	Document Type Definition
EPSG	European Petroleum Survey Group
GIS	Geographic Information System
GML	Geography Markup Language
NOTE The abbreviated term GML was previously used also as Generalized Markup Language (which led to SGML, Standard Generalized Markup Language, ISO 8879).	
HTTP	Hypertext Transfer Protocol
IETF	Internet Engineering Task Force
ISO	International Organization for Standardization
OGC	Open Geospatial Consortium
RDF	Resource Description Framework
RFC	Request for Comments

SMIL	Synchronized Multimedia Integration Language
SOAP	Simple Object Access Protocol
SVG	Scalable Vector Graphics
UML	Unified Modeling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
W3C	World Wide Web Consortium
WFS	Web Feature Service
XML	eXtensible Markup Language
XSLT	eXtensible Stylesheet Language — Transformations
0D	zero-dimensional
1D	one-dimensional
2D	two-dimensional
3D	three-dimensional

4 Conformance

4.1 Conformance requirements

Clauses 7 to 19 of this document specify XML Schema components, i.e. the GML schema, which shall be used in GML application schemas in accordance with Clause 21. Clause 20 specifies rules for the specification of a GML profile that may be defined for use in a GML application schema.

Few applications will require the full range of capabilities described by the GML schema. This clause, therefore, defines a set of conformance classes that will support applications whose requirements range from the minimum necessary to define simple feature types to full use of the GML schema.

Most of the schema components specified in this document implement concepts defined in the ISO 19100 series of International Standards. In these cases, the conformance classes defined in this document are based on the conformance classes defined in the corresponding standard.

Any GML application schema, GML profile or software implementation claiming conformance with one of the conformance classes shall pass all test cases of the corresponding abstract test suite.

Any software implementation claiming conformance to this document shall document the GML profile supported by the implementation. The GML profile shall pass all mandatory test cases of the abstract test suite corresponding to GML profiles.

4.2 Conformance classes related to GML application schemas

GML application schemas claiming conformance to this document shall conform to the rules specified in Clauses 7 to 21 and pass all relevant test cases of the abstract test suite in A.1.

Depending on the characteristics of a GML application schema, 12 conformance classes are distinguished. Table 1 lists these classes and the corresponding subclause of the abstract test suite.

Table 1 — Conformance classes related to GML application schemas

Conformance class	Subclause of the abstract test suite
All GML application schemas	A.1.1
GML application schemas converted from an ISO 19109 application schema in UML	A.1.2
GML application schemas to be converted to an ISO 19109 application schema in UML	A.1.3
GML application schemas defining features and feature collections	A.1.4
GML application schemas defining spatial geometries	A.1.5
GML application schemas defining spatial topologies	A.1.6
GML application schemas defining time	A.1.7
GML application schemas defining coordinate reference systems	A.1.8
GML application schemas defining coverages	A.1.9
GML application schemas defining observations	A.1.10
GML application schemas defining dictionaries and definitions	A.1.11
GML application schemas defining values	A.1.12

4.3 Conformance classes related to GML profiles

The requirements of an application schema determine the XML Schema components from the GML schema that shall be included in a GML profile. GML profiles claiming conformance to this document shall satisfy the requirements of the abstract test suite in A.2.

Depending on the contents and requirements concerning a specific GML profile, 31 conformance classes are distinguished. Table 2 lists these classes and the corresponding subclause of the abstract test suite.

Table 2 — Conformance classes related to GML profiles

Conformance class	Subclause of the abstract test suite
All GML profiles	A.2.1
Geometric primitives (spatial) — 0-dimensional	A.2.2.1.1
Geometric primitives (spatial) — 0/1-dimensional	A.2.2.1.2
Geometric primitives (spatial) — 0/1/2-dimensional	A.2.2.1.3
Geometric primitives (spatial) — 0/1/2/3-dimensional	A.2.2.1.4
Geometric complexes (spatial) — 0/1-dimensional	A.2.3.1.1
Geometric complexes (spatial) — 0/1/2-dimensional	A.2.3.1.2
Geometric complexes (spatial) — 0/1/2/3-dimensional	A.2.3.1.3
Topologic complexes (spatial) — 0/1-dimensional	A.2.4.1.1
Topologic complexes (spatial) — 0/1/2-dimensional	A.2.4.1.2
Topologic complexes (spatial) — 0/1/2/3-dimensional	A.2.4.1.3
Topologic complexes with geometric realization (spatial) — 1-dimensional	A.2.5.1.1
Topologic complexes with geometric realization (spatial) — 2-dimensional	A.2.5.1.2
Topologic complexes with geometric realization (spatial) — 3-dimensional	A.2.5.1.3
Coordinate reference systems	A.2.6
Coordinate operations between two coordinate reference systems	A.2.7
Temporal geometry — 0-dimensional	A.2.8.1
Temporal geometry — 0/1-dimensional	A.2.8.2
Temporal topology	A.2.9

Table 2 (continued)

Conformance class	Subclause of the abstract test suite
Temporal reference systems	A.2.10
Dynamic features	A.2.11
Dictionaries	A.2.12
Units dictionaries	A.2.13
Observations	A.2.14
Abstract coverage	A.2.15.1
Discrete point coverage	A.2.15.2
Discrete curve coverage	A.2.15.3
Discrete surface coverage	A.2.15.4
Discrete solid coverage	A.2.15.5
Grid coverage	A.2.15.6
Continuous coverage	A.2.15.7

Curve implementations, for those GML profiles including 1-dimensional spatial geometry objects, shall always include a “linear” interpolation technique. Surface implementations, for those GML profiles including 2-dimensional spatial geometry objects, shall always include a “planar” interpolation technique. Additional curve and surface interpolation mechanisms are optional but, if implemented, they shall follow the definition included in this document.

NOTE 1 Compare these conformance classes with ISO 19107:2003, Clause 2, ISO 19108:2002, 2.2, and ISO 19123:2005, Clause 2.

NOTE 2 A GML profile conforming to the three conformance classes “Geometric primitives (spatial) — 0-dimensional”, “Geometric primitives (spatial) — 0/1-dimensional”, and “Geometric primitives (spatial) — 0/1/2-dimensional” (in addition to conformance class “All GML profiles”) conforms to the spatial profile defined in ISO 19137:2007 and the respective conformance tests in ISO 19137:2007, B.1, B.2 and B.3.

4.4 Conformance classes related to GML documents

GML documents claiming conformance to this document shall conform to the rules specified in Clauses 7 to 21 and pass all relevant test cases of the abstract test suite in A.3.

4.5 Conformance classes related to software implementations

Software implementations reading or writing GML or GML application schemas claiming conformance to this document shall pass all of the corresponding abstract test suites described in the abstract test suite in Annex B.

Depending on the capabilities of the implementation, 11 conformance classes are distinguished. Table 3 lists these classes and the corresponding subclause of the abstract test suite.

Table 3 — Conformance classes related to implementations

Conformance class	Subclause of the abstract test suite
All software implementations	B.1
Support for remote simple Xlinks	B.2.1
Support for extended Xlinks	B.2.2
Support for nillable properties	B.2.3
Support for units of measurement	B.2.4
Support for ownership semantics of properties	B.2.5

Table 3 (continued)

Conformance class	Subclause of the abstract test suite
Metadata properties	B.2.6
Support for GML profiles in instance validation	B.2.7
Writing GML	B.3
Reading GML	B.4
Writing GML application schemas	B.5
Reading GML application schemas	B.6

5 Conventions

5.1 XML namespaces

All components of the GML schema are defined in the namespace with the identifier "http://www.opengis.net/gml/3.2", for which the prefix **gml** or the default namespace is used within this document.

All components described by the W3C Xlink Recommendation are defined in the namespace with the identifier "http://www.w3.org/1999/xlink", for which the prefix **xlink** is used within this document.

NOTE The schema components in both namespaces are documented in XML Schema documents in Annex C.

5.2 Versioning

Each schema document specifying components of the GML schema shall carry a version attribute as defined in the XML Schema Recommendation. The format of the version attribute string is x.y.z where x denotes the major version number, y denotes a minor version number and z denotes a bug fix release for that document. The version described by this document is 3.2.2.

NOTE GML 3.2 is the first version of GML as an ISO standard. Previous versions of GML have been developed and published by the Open Geospatial Consortium (OGC).

5.3 Deprecated parts of previous versions of GML

The verb "**deprecate**" provides notice that the referenced portion of this document is being retained for backwards compatibility with earlier versions but may be removed from a future version without further notice.

Sections of this document that describe or refer to deprecated GML components are written in *italics*.

NOTE 1 This document is published by the Open Geospatial Consortium as GML 3.2.2, the previous adopted version of GML in the Open Geospatial Consortium was 3.1.1.

NOTE 2 All schema components that were part of version 2.1 of GML but were deprecated in version 3.0 of GML have been removed and are not supported by this document.

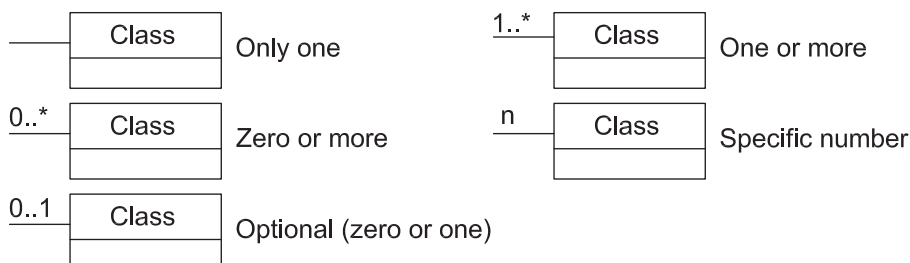
5.4 UML notation

Many diagrams that appear in this document are presented using the Unified Modeling Language (UML) static structure diagram. The UML notations used in this document are described in Figure 1.

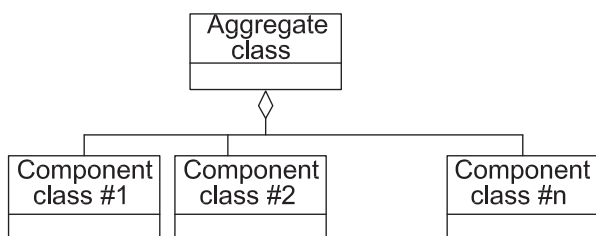
Association between classes



Association Cardinality



Aggregation between classes



Class Inheritance (subtyping of classes)

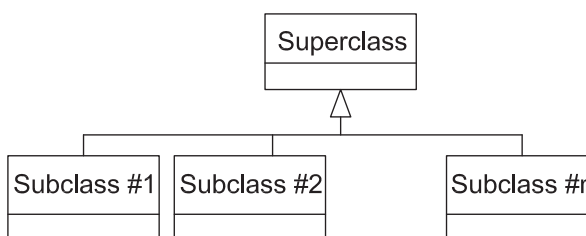


Figure 1 — UML notation

In this document, the following stereotypes of UML class are used:

- `<<DataType>>` is a set of properties that lack identity (independent existence and the possibility of side effects). A `DataType` is a class with no operations whose primary purpose is to hold the information.
- `<<Union>>` is a set of properties. The semantics is that only one of the properties may be present at any time.
- `<<FeatureType>>` is a feature as defined in ISO 19109.
- `<<CodeList>>` is a flexible enumeration that uses string values for expressing a list of potential values.
- `<<Enumeration>>` is a fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
- `<<Abstract>>` is an abstract object type (the stereotype is used in addition to formatting the class name in italics).
- `<<Type>>` is a set of abstract attributes and associations. Abstract means that their specification does not imply that they have to be concretely implemented as instance variables.

In this document, the following standard data types are used:

- `CharacterString` — A sequence of characters (in general this data type is mapped to “string” in XML Schema).
- `Integer` — An integer number (in general this data type is mapped to “integer” in XML Schema).
- `Real` — A floating point number (in general this data type is mapped to “double” in XML Schema).

- Boolean — A value specifying TRUE or FALSE (in general this data type is mapped to “boolean” in XML Schema).

5.5 XML Schema

The normative parts of this document use the W3C XML Schema language to describe the grammar of conformant GML data instances. XML Schema is a rich language with many capabilities and subtleties. While a reader who is unfamiliar with XML Schema may be able to follow the description in a general fashion, this document is not intended to serve as an introduction to XML Schema. In order to have a full understanding of this document it is necessary for the reader to have a reasonable knowledge of XML Schema.

6 Overview of the GML schema

6.1 GML schema

GML specifies XML encodings of a number of the conceptual classes defined in the ISO 19100 series of International Standards and the OpenGIS Abstract Specification in conformance with these standards and specifications.

The relevant conceptual models include those defined in:

- ISO 19103 — Conceptual schema language (units of measure, basic types);
- ISO 19107 — Spatial schema (spatial geometry and topology);
- ISO 19108 — Temporal schema (temporal geometry and topology, 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 (coverages, grids).

In many cases, the mapping from the conceptual classes to XML is straightforward, while in some cases the mapping is more complex. For both cases, the mapping is documented in detail in Annex D.

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. Examples include moving objects, simple observations or value objects. Additional conceptual classes corresponding to these extensions are also specified in Annex D.

The GML schema comprises the components (e.g. XML elements, attributes, simple types, complex types, attribute groups, groups) that are described in this document. The XML encoding conforms to ISO 19118.

6.2 GML application schemas

Designers of GML application schemas may extend or restrict the types defined in the GML schema to define appropriate types for an application domain. Non-abstract elements, attributes and types from the GML schema may be used directly in an application schema, if no changes are required.

Following ISO 19109, the feature types of an application or application domain are specified in an application schema. A GML application schema shall be specified in XML Schema and import the GML schema. It may be constructed in one of two different ways:

- By adhering to the rules for GML application schemas specified in Clause 21 for creating a GML application schema directly in XML Schema.

- 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 Annex E of this document. The mapping from an ISO 19109 conformant Application Schema in UML to the corresponding GML application schema is based on a set of encoding rules. These encoding rules conform with the rules for GML application schemas and ISO 19118.

Both ways are valid approaches to construct GML application schemas. All application schemas shall be modelled in accordance with the General Feature Model specified in ISO 19109. Within the ISO 19100 series of International Standards, UML is the preferred language to describe conceptual schemas.

The second approach is recommended in general to ensure proper use of the conceptual modelling framework of the ISO 19100 series of International Standards. However, the following reasons are examples where it may be justified to apply the first approach:

- Additional capabilities of the GML schema may be required in addition to the capabilities that are accessible by using the encoding rules specified in Annex E.
- Only an XML representation may be required and the application schema may be relatively simple, so the use of a conceptual schema language may be considered an unjustified overhead.
- The application may need a more optimized or compact XML encoding than the one that is the result of the encoding rules specified in Annex E.

NOTE Annex F provides rules for mapping a GML application schema to an ISO 19109 conformant Application Schema in UML.

In both cases, GML application schemas conformant with this document shall use all of the applicable GML schema components, either directly or by specialization, and are valid in accordance with the rules for XML Schema. How the GML application schemas were produced is not relevant for conformance to the requirements of this document.

6.3 Relationship between the ISO 19100 series of International Standards, the GML schema and GML application schemas

The approach taken by this document is shown in Figure 2. The two main aspects are:

- Clear documentation of the conceptual model of GML: The profile of the ISO 19100 series of International Standards that is implemented by GML is documented as well as the extensions to this profile.
- Support for application schema development either in UML or XML Schema: In order to achieve this two-way mapping between UML (i.e. ISO 19109 conformant application schemas in UML) and XML Schema (i.e. GML application schemas in XML Schema) the constructs used in both representations have been limited. While this reduces the expressiveness of the schema descriptions to some extent, this also reduces their complexity and may make them easier to implement.

NOTE While the mapping from UML to XML Schema is discussed in ISO 19118:2011, Annex A, the reverse mapping is not discussed in any other standard in the ISO 19100 series of International Standards.

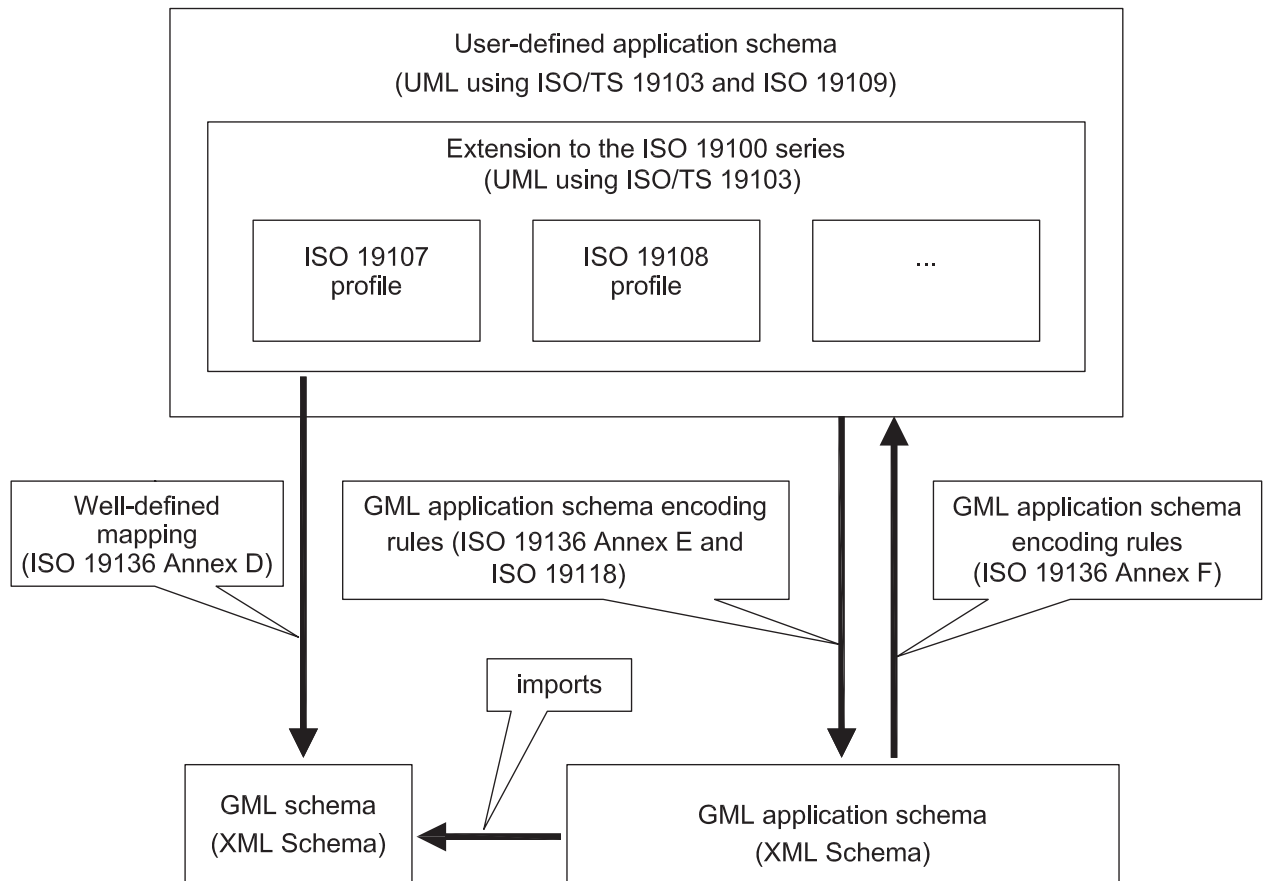


Figure 2 — Relationship between the ISO 19100 series of International Standards and ISO 19136/GML

6.4 Organization of this document

GML defines the various entities, e.g. features, geometries, topologies, through a hierarchy of GML object types. The mapping between GML object types and classes in the conceptual model of the ISO 19100 series of International Standards and the OGC Abstract Specification is shown in Table D.2. The normative GML schema is organized around these object types.

Subclause 7.2 describes basic schema components of GML. It defines the root object, `gml:AbstractObject`, and the root of the GML class hierarchy, `gml:AbstractGML`.

Subclause 8.1 describes the Xlink schema. This schema is an OGC implementation of the XLink specification using XML Schema. It may be replaced in some future release by an equivalent schema from the W3C.

NOTE 1 Within this document an XML Schema description is provided for xlink components. This is provided for convenience in the context of an XML Schema-based environment. The normative definitions are given a non-XML Schema form in the XLink Recommendation.

Subclause 8.2 defines the GML representation of some basic data types that are used in the GML schema. Most of these types are simple types or simple content types.

Clause 9 describes the feature schema components which defines `gml:AbstractFeature` and some derived components.

Clause 10, 10.5.10 and Clause 11 describe the geometry schema components that define `gml:AbstractGeometry`, `gml:AbstractGeometricPrimitive`, `gml:AbstractGeometricAggregate`, `gml:GeometricComplex` and some derived components.

Clause 12 describes the coordinate reference system schema components that define the subtypes of `gml:IdentifiedObject`, `gml:AbstractCRS`, `gml:AbstractCoordinateReferenceSystem`, and the elements and types required to construct specific coordinate reference systems.

Clause 13 describes the schema components for topology which define `gml:AbstractTopology`, `gml:AbstractTopoPrimitive`, `gml:TopoComplex` and some derived components.

Clause 14 describes the schema components for temporal constructs defining `gml:AbstractTimeObject`, `gml:AbstractTimePrimitive`, `gml:AbstractTimeGeometricPrimitive`, `gml:AbstractTimeTopologyPrimitive`, `gml:AbstractTimeComplex` and derived components as well as `gml:DynamicFeature` and derived components.

Clause 15 describes the schema components for definitions and dictionaries including `gml:Definition` and `gml:Dictionary`.

Clause 16 describes the schema components for the construction of units of measure (`gml:UnitDefinition` and derived components), measures and value objects (`gml:AbstractValue`, `gml:AbstractScalarValue`, `gml:AbstractScalarValueList` and derived components).

Clause 17 describes the schema components for the description of direction.

Clause 18 describes the schema components for simple observations (`gml:Observation` and derived components).

Clause 19 describes the schema components for grids and coverages. This describes `gml:Grid`, `gml:AbstractCoverage`, `gml:AbstractDiscreteCoverage`, `gml:AbstractContinuousCoverage` and derived components.

These clauses describe the normative GML schema and explain their contents, structure and dependencies.

The representation of the GML schema presented in this document uses the XML interchange format provided by W3C XML Schema. The descriptions of the set of components are factored into schema documents, where each document gathers together components that correspond broadly to the classification shown in Figure 2. However, while the XML representation of each GML schema component in this document is normative, the packaging into schema documents is not. Clause 20 (profiles) and Annex G (subsetting) describe principles and methods for alternative packaging of the XML representation of GML schema components.

All components defined or declared in this document use the same target namespace of `http://www.opengis.net/gml/3.2`.

NOTE 2 XML namespaces provide a mechanism for avoiding ambiguity arising from name clashes within XML documents. All components described in a single schema document are in a single target namespace, but more than one schema document can describe components in a namespace. Within the XML development community there are precedents for assigning either one or several namespaces to a set of schema components for a single application. The use of a single namespace for GML schema components is consistent with the non-normative factoring of the XML representation of GML components between schema documents.

UML uses packages to collect related components. Furthermore, within the ISO 19100 series of International Standards, prefixes following the pattern "AA_" are used to distinguish classes from different packages in a way that resembles XML namespaces. However, for the reasons given above, packaging of GML components is non-normative and all GML components are in a single namespace, so no correspondence between the two letter prefixes in the ISO 19100 series of International Standards and XML namespaces in GML is possible.

6.5 Deprecated and experimental schema components

Experimental, informative schema components dealing with rules for a default styling of GML objects are described in Annex H.

Deprecated global schema components (elements, attributes, types) are included in Annex I **Documents**

7 GML schema — General rules and base schema components

7.1 GML model and syntax

7.1.1 GML instance documents

GML uses an explicit syntax to instantiate a GML application schema conformant with the General Feature Model defined in ISO 19109 in an XML document.

A feature is encoded as an XML element with the name of the feature type. Other identifiable objects are encoded as XML elements with the name of the object type.

Each feature attribute and feature association role is a property of a feature. Feature properties are encoded in an XML element.

NOTE 1 The term "attribute" in XML refers to a specific syntactic component in XML documents, so to avoid confusion when describing the XML encoding, GML follows RDF (W3C, 1999) terminology and uses the term property rather than attribute or association role. The General Feature Model (ISO 19109) also uses the term "property" as a generalization for "attribute", "association role" or "operation".

Furthermore, the property semantics, which is indicated by the name of the element representing the property, is distinguished from the property value, which is given by the content of the property element. A property element may contain its value as content encoded inline, or reference its value with a simple XLink. The value of a property may be simple, or it may be a feature or other complex object. When recorded inline, the value of a simple property is recorded as a literal value with no embedded markup (text), while if the value is complex it appears as a subtree using XML markup (i.e. an XML element with sub-structure).

NOTE 2 The GML model has a straightforward representation using the UML profile used in the ISO 19100 series of International Standards (defined in ISO 19103). This is described in detail in Annex D and Annex E, but can be summarized approximately and briefly as follows.

Features are represented

- in UML by objects, where the name of the feature type is used as the name of the object class;
- in GML instances by XML elements, where the name of the feature type is used as the name of the element.

Feature properties are represented

- in UML by association roles with feature type classes, and attributes of feature type classes, where the property semantics are given by the association role name or attribute name;
- in GML instances by sub-elements (known as property elements) of feature elements, where the property semantics are given by the property element name.

The property value has a type indicated

- in UML by the class of the association target, or by the data type of the attribute;
- in GML, in the case of properties with complex values, by the name of the object element contained within the property element and in case of a property with simple value by the type of the literal value containing no embedded XML markup.

The result is a layered XML document, in which XML elements corresponding to features, objects or values occur interleaved with XML elements corresponding to the properties that relate them. The

function of a feature, object or value in context can always be determined by inspecting the name of the property element which directly contains it, or which carries the reference to it.

NOTE 3 This encoding pattern is sometimes referred to as the “object-property model” and has been the basis of the GML encoding model since the first version was adopted by OGC. While in some cases this encoding pattern adds extra levels of elements in instance documents it also provides significant benefits: It helps to make a GML instance document understandable on its own, provides a predictable structure and avoids too heavy reliance on XML Schema as it is expected that GML instance documents can outlive the common use of W3C XML Schema language.

7.1.2 Lexical conventions

There are several lexical conventions used in the GML schema for the names of elements and complex types to assist in human comprehension of GML instances and schemas:

- objects are instantiated as XML elements with a conceptually meaningful name in UpperCamelCase;
- properties are instantiated as XML elements whose name is in lowerCamelCase;
- abstract elements have a prefix “Abstract” (objects) or “abstract” (properties) prepended to their name;
- the names of XML Schema complex types are in UpperCamelCase ending in the word “Type”;
- abstract XML Schema complex types have the word “Abstract” prepended.

It is strongly recommended to follow these conventions also in GML application schemas. The rules are only applicable in languages that distinguish between upper and lower case.

NOTE UpperCamelCase is a naming convention in which a name is formed of multiple words that are joined together as a single word with the first letter of each of the multiple words capitalized within the new word that forms the name. lowerCamelCase is a variation in which the first letter of the new word is lower case, allowing it to be easily distinguished from an UpperCamelCase name.

7.1.3 XML Schema definition of GML language

The GML schema consists of W3C XML Schema components that define types and declare

- XML elements to encode GML objects with identity,
- XML elements to encode GML properties of those objects, and
- XML attributes qualifying those properties.

A GML object is an XML element of a type derived directly or indirectly from `gml:AbstractGMLType`. From this derivation, a GML object may have a `gml:id` attribute.

A GML property shall not be derived from `gml:AbstractGMLType`, shall not have a `gml:id` attribute, or any other attribute of XML type ID.

An element is a GML property if and only if it is a child element of a GML object.

A GML object shall not appear as the immediate child of a GML object.

Consequently, no element may be both a GML object and a GML property.

All XML attributes declared in the GML schema are defined without namespace, the only exception is the `gml:id` XML attribute.

The use of additional XML attributes in a GML application schema is discouraged.