

DIN EN ISO 19109

ICS 35.240.70

Ersatz für
DIN EN ISO 19109:2006-09**Geoinformation –
Regeln zur Erstellung von Anwendungsschemata (ISO 19109:2015);
Englische Fassung EN ISO 19109:2015**

Geographic information –
Rules for application schema (ISO 19109:2015);
English version EN ISO 19109:2015

Information géographique –
Règles de schéma d'application (ISO 19109:2015);
Version anglaise EN ISO 19109:2015

Gesamtumfang 105 Seiten

DIN-Normenausschuss Bauwesen (NABau)

Nationales Vorwort

Dieses Dokument (EN ISO 19109:2015) wurde vom Technischen Komitee ISO/TC 211 „Geographic information/Geomatics“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 287 „Geoinformation“, dessen Sekretariat von BSI (Vereinigtes Königreich) gehalten wird, erarbeitet.

Der für die deutsche Mitarbeit zuständige Arbeitsausschuss ist der als Spiegelausschuss zum CEN/TC 287 und ISO/TC 211 eingesetzte Arbeitsausschuss NA 005-03-03 AA „Geoinformation“ des DIN-Normenausschusses Bauwesen (NABau).

Das Präsidium des DIN hat mit seinem Beschluss 1/2004 festgelegt, dass von dem in den Regeln der europäischen Normungsarbeit von CEN/CENELEC verankerten Grundsatz, wonach Europäische Normen in den drei offiziellen Sprachen Deutsch, Englisch und Französisch veröffentlicht werden, in begründeten Ausnahmefällen abgewichen und auf die deutsche Sprachfassung verzichtet werden kann.

Die Genehmigung dafür hat die DIN-Geschäftsleitung entsprechend den festgelegten Kriterien für die vorliegende Norm auf Antrag des Normenausschusses Bauwesen (NABau), Fachbereich 03 „Geodäsie; Geoinformation“ erteilt.

Änderungen

Gegenüber DIN EN ISO 19109:2006-09 wurden folgende Änderungen vorgenommen:

- a) Klarere Struktur der Konformitätsklassen im Einklang mit den entsprechenden Empfehlungen von ISO/TC 211;
- b) Berücksichtigung von Metadaten zur Bestimmung von Eigenschaften eines Features nach DIN EN ISO 19156, *Geoinformation — Erdbeobachtung und Erdmessung*;
- c) Anpassung an ISO 19103:2015 und Definition eines UML-Profiles für DIN EN ISO 19109;
- d) Anpassung des General Feature Model an die Nutzung in der Praxis;
- e) generelle Überarbeitung für eine klarere Darstellung der Anforderungen und Empfehlungen.

Frühere Ausgaben

DIN EN ISO 19109: 2006-09

Nationaler Anhang NA (informativ)

Begriffe

Die Benennungen der folgenden Begriffe sind identisch mit den Benennungen in der Englischen Fassung.

4 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

4.1

Anwendung

(en: application)

Be- und Verarbeitung von Daten zur Unterstützung von Nutzeranforderungen

[QUELLE: ISO 19101-1:2014, 4.1.1]

4.2

Anwendungsschema

(en: application schema)

konzeptuelles Schema (4.5) für Daten, das für eine oder mehrere *Anwendungen* (4.1) erforderlich ist

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

4.3

komplexes Feature

(en: complex feature)

Feature (4.9), das sich aus anderen Features zusammensetzt

4.4

konzeptuelles Modell

(en: conceptual model)

Modell (4.15), das einen abstrahierten *Ausschnitt der realen Welt* (4.19) abbildet

[QUELLE: ISO 19101-1:2014, 4.1.5]

4.5

konzeptuelles Schema

(en: conceptual schema)

formale Beschreibung eines *konzeptuellen Modells* (4.4)

[QUELLE: ISO 19101-1:2014, 4.1.6]

4.6

Coverage

(en: coverage)

Feature (4.9), das in Form einer Funktion *Werte* (4.20) für jede Position innerhalb seines räumlichen, zeitlichen oder raum-zeitlichen *Bereichs* (4.8) liefert

[QUELLE: ISO 19123:2005, 4.1.7]

4.7

Datensatz

(en: dataset)

identifizierbare Sammlung von Daten

[QUELLE: ISO 19115-1:2014, 4.3]

4.8

Bereich

(en: domain)

wohldefiniertes (Fach-) Gebiet oder bestimmter Wertebereich

Anmerkung 1 zum Begriff: Wohldefiniert bedeutet, dass eine Definition notwendig und hinreichend ist, sprich alles, was die Definition erfüllt, ist innerhalb des Wertebereichs und alles, was die Definition nicht erfüllt, ist außerhalb des Wertebereichs.

4.9

Feature

(en: feature)

Abstraktion eines Phänomens der realen Welt

Anmerkung 1 zum Begriff: Ein Feature kann als ein Typ oder eine Instanz vorkommen. Feature-Klasse oder Feature-Instanz ist zu verwenden, wenn nur eines gemeint ist.

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

4.10

Feature-Assoziation

(en: feature association)

Beziehung, die Instanzen einer *Feature*- (4.9) Klasse mit Instanzen derselben oder einer anderen Feature-Klasse verbindet

[QUELLE: ISO 19110:2005, 4.2]

4.11

Feature-Attribut

(en: feature attribute)

Merkmal eines *Features* (4.9)

Anmerkung 1 zum Begriff: Ein Feature-Attribut kann als ein Typ oder eine Instanz vorkommen. Feature-Attribut-Klasse oder Feature-Attribut-Instanz ist zu verwenden, wenn nur eines gemeint ist.

Anmerkung 2 zum Begriff: Ein Feature-Attribut hat einen Name, einen Datentyp und einen *Bereich* (4.8). Ein Feature-Attribut besitzt einen Attributwert (4.20), der aus dem Bereich der Feature-Attribut-Klassen stammt.

[QUELLE: ISO 19101-1:2014, 4.1.12, modifiziert – Anmerkungen und Beispiele in 19101-1 wurden gestrichen und andere Anmerkungen hinzugefügt.]

4.12

Feature-Operation

(en: feature operation)

Operation, die jede Instanz einer *Feature*- (4.9) Klasse ausführen kann

BEISPIEL 1 Eine Feature-Operation an einem „Damm“ ist die Erhöhung des Damms. Die Ergebnisse dieser Operation sind die Erhöhung des „Damms“ und des Wasserstands in einem „Becken“.

BEISPIEL 2 Eine Feature-Operation der Feature-Klasse „Damm“ könnte sein, das Navigieren von Schiffen entlang eines Wasserlaufs zu verhindern.

[QUELLE: ISO 19110:2005, 4.5, modifiziert – Die Anmerkung zum Begriff in ISO 19110:2005 wurde gestrichen. Ein zweites Beispiel wurde hinzugefügt.]

4.13

geographische Daten

(en: geographic data)

Daten mit einem impliziten oder expliziten Ortsbezug zur Erde

Anmerkung 1 zum Begriff: „Geoinformation“ wird auch als Begriff für Informationen zu Phänomen mit einem impliziten oder expliziten Ortsbezug zur Erde verwendet

4.14

Metadaten

(en: meta data)

Information über eine Ressource

[QUELLE: ISO 19115-1:2014, 4.10]

4.15

Modell

(en: model)

Abstraktion einiger Aspekte der Realität

4.16

Beobachtung

(en: observation)

Messvorgang oder anderer Vorgang zur Ermittlung des *Werts* (4.20) einer *Eigenschaft* (4.17)

[QUELLE: ISO 19156:2011, 4.11]

4.17

Eigenschaft

(en: property)

benannter Aspekt oder benanntes Attribut eines Objekts

[QUELLE: ISO 19143:2010, 4.21]

4.18

Qualität

(en: quality)

Grad, in dem ein Satz inhärenter Merkmale Anforderungen erfüllt

[QUELLE: ISO 9000:2005, 3.1.1]

4.19

Gegenstandsbereich

Ausschnitt der realen Welt

(en: universe of discourse)

Sicht der realen oder hypothetischen Welt, die die Gesamtheit dessen umfasst, was von Interesse ist

[QUELLE: ISO 19101-1:2014, 4.1.38]

4.20

Wert

(en: value)

Element eines Typs und *Bereichs* (4.8)

[QUELLE: ISO/IEC 19501:2005, 0000_5]

English Version

Geographic information —
Rules for application schema
(ISO 19109:2015)

Information géographique —
Règles de schéma d'application
(ISO 19109:2015)

Geoinformation —
Regeln zur Erstellung von Anwendungsschemata
(ISO 19109:2015)

This European Standard was approved by CEN on 20 November 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

This document (EN ISO 19109:2015) 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 June 2016, and conflicting national standards shall be withdrawn at the latest by June 2016.

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

This document supersedes EN ISO 19109:2006.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 19109:2015 has been approved by CEN as EN ISO 19109:2015 without any modification.

Contents

Page

Foreword	vi
Introduction	vii
1 Scope	1
2 Conformance	1
2.1 General	1
2.2 Meta-model	1
2.3 UML application schema	2
2.4 Profiling standard schema	2
2.5 Metadata	2
2.6 Quality	2
2.7 Temporal	2
2.8 Spatial	3
2.9 Coverages	3
2.10 Observations	3
2.11 Spatial referencing by identifiers	3
2.12 Code list	3
2.13 Multi-lingual support	4
3 Normative references	4
4 Terms and definitions	4
5 Presentation and abbreviations	7
5.1 Presentation	7
5.1.1 General	7
5.1.2 Conformance class	7
5.1.3 Requirements class	7
5.1.4 Rules	7
5.1.5 Identifiers	8
5.1.6 Conceptual schemas	8
5.1.7 Descriptions of concepts	8
5.2 Abbreviations	8
5.3 Package abbreviations	8
6 Context	9
6.1 Purpose of an application schema	9
6.2 Rules for application schema	9
6.3 Application schema supporting data interchange	10
6.3.1 Introduction	10
6.3.2 Data interchange by transfer	10
6.3.3 Data interchange by transactions	11
7 Principles for defining features	12
7.1 General	12
7.2 Features, Coverages and Properties	13
7.2.1 Features	13
7.2.2 Coverages	13
7.2.3 Properties and observations	14
7.3 Features and the application schema	14
7.4 The General Feature Model	16
7.4.1 Introduction	16
7.4.2 The purpose of the GFM	16
7.4.3 The main structure of the GFM	16
7.4.4 IdentifiedType	18
7.4.5 FeatureType	18
7.4.6 PropertyType	19
7.4.7 AttributeType	19

7.4.8	Operation.....	20
7.4.9	FeatureAssociationRole	21
7.4.10	ValueAssignment	21
7.4.11	FeatureAssociationType.....	23
7.4.12	InheritanceRelation.....	23
7.5	Attributes of feature types.....	24
7.5.1	Introduction.....	24
7.5.2	SpatialAttributeType	24
7.5.3	TemporalAttributeType	24
7.5.4	QualityAttributeType	25
7.5.5	LocationAttributeType	25
7.5.6	MetadataAttributeType.....	25
7.5.7	ThematicAttributeType	25
7.5.8	CoverageFunctionAttributeType.....	25
7.6	Relationships between feature types	25
7.6.1	Introduction.....	25
7.6.2	InheritanceRelation.....	25
7.6.3	FeatureAssociationType.....	26
7.7	Constraints	27
8	Rules for application schema in UML.....	27
8.1	The application modelling process.....	27
8.2	The application schema.....	28
8.2.1	General.....	28
8.2.2	Conceptual schema language for application schemas	28
8.2.3	Packaging and identification of an application schema.....	30
8.2.4	Documentation of an application schema.....	30
8.2.5	Integration of application schemas and standard schemas	30
8.2.6	Modelling structures in UML.....	32
8.3	Domain profiles of standard schemas in UML	37
8.3.1	Introduction.....	37
8.3.2	Adding information to a standard schema	37
8.3.3	Tailored use of standard schemas.....	38
8.4	Rules for use of metadata schema	39
8.4.1	Introduction.....	39
8.4.2	Metadata for features, feature attributes, and feature associations.....	40
8.5	Rules for use of quality schema	40
8.5.1	Introduction.....	40
8.5.2	Data quality rules	41
8.6	Temporal rules.....	44
8.6.1	Rules for modelling applications with temporal properties	44
8.6.2	Use of the temporal conceptual schema.....	44
8.6.3	Temporal attributes.....	44
8.6.4	Temporal associations between features	46
8.7	Spatial rules.....	48
8.7.1	Rules for modelling applications with spatial properties	48
8.7.2	Use of standard spatial schema.....	49
8.7.3	Spatial attributes	50
8.7.4	Use of geometric aggregates and spatial complexes to represent the values of spatial attributes of features.....	51
8.7.5	Spatial associations between features	55
8.7.6	Features sharing geometry.....	57
8.7.7	Point features, line features and area features	58
8.7.8	Defining interpolation methods	58
8.7.9	Independent spatial complexes	59
8.8	Rules for use of coverage functions.....	61
8.9	Rules for the use of observations	63
8.10	Spatial referencing using geographic identifiers.....	66
8.11	Code lists, vocabularies, lexicons	68

8.12 Linguistic adaptation.....	69
Annex A (normative) Abstract test suite	70
Annex B (informative) The modelling approach and the General Feature Model	82
Annex C (informative) Application schema examples	85
Bibliography	91

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. 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. 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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 211, *Geographic information/Geomatics*.

This second edition cancels and replaces the first edition (ISO 19109:2005).

Introduction

Any description of reality is always an abstraction, always partial, and always just one of many possible “views”, depending on the application field.

The widespread application of computers and geographic information systems (GIS) has led to an increased use of geographic data within multiple disciplines. With current technology as an enabler, society’s reliance on such data is growing. Geographic datasets are increasingly being shared and exchanged. They are also used for purposes other than those for which they were produced.

To ensure that data will be understood by both computer systems and users, the data structures for data access and exchange must be fully documented. The interfaces between systems, therefore, need to be defined with respect to data and operations, using the methods standardized in this International Standard. For the construction of internal software and data storage within proprietary systems, any method may be used that enables the standardized interfaces to be supported.

An application schema provides the formal description of the data structure and content required by one or more applications. An application schema contains the descriptions of both geographic data and other related data. A fundamental concept of geographic data is the feature.

— This page is intentionally blank —

Geographic information — Rules for application schema

1 Scope

This International Standard defines rules for creating and documenting application schemas, including principles for the definition of features.

The scope of this International Standard includes the following:

- conceptual modelling of features and their properties from a universe of discourse;
- definition of application schemas;
- use of the conceptual schema language for application schemas;
- transition from the concepts in the conceptual model to the data types in the application schema;
- integration of standardized schemas from other ISO geographic information standards with the application schema.

The following are outside the scope:

- choice of one particular conceptual schema language for application schemas;
- definition of any particular application schema;
- representation of feature types and their properties in a feature catalogue;
- representation of metadata;
- rules for mapping one application schema to another;
- implementation of the application schema in a computer environment;
- computer system and application software design;
- programming.

2 Conformance

2.1 General

This International Standard defines 12 conformance classes shown in [Tables 1 to 12](#), matching the 12 requirements classes described in [Clauses 7 and 8](#). Any application schema claiming conformance to any requirements class in this International Standard shall pass all of the tests listed in the corresponding conformance class, which are described in detail in the abstract test suites in [Annex A](#). Each test relates to one or more specific requirements, which are explicitly indicated in the description of the test.

2.2 Meta-model

Table 1 — Meta-model conformance class

Conformance class	/conf/general
Requirements	/req/general (Clause 7, Table 15)
Tests	All tests in A.2

2.3 UML application schema

Table 2 — UML application schema conformance class

Conformance class	/conf/uml
Dependency	/conf/general (2.2)
Requirements	/req/uml (8.2, Table 16)
Tests	All tests in A.3

2.4 Profiling standard schema

Table 3 — Profiling standard schema conformance class

Conformance class	/conf/profile
Dependency	/conf/uml (2.3)
Requirements	/req/profile (8.3, Table 19)
Tests	All tests in A.4

2.5 Metadata

Table 4 — Metadata conformance class

Conformance class	/conf/metadata
Dependency	/conf/uml (2.3)
Requirements	/req/metadata (8.4, Table 20)
Tests	All tests in A.5

2.6 Quality

Table 5 — Quality conformance class

Conformance class	/conf/quality
Dependency	/conf/uml (2.3)
Requirements	/req/quality (8.5, Table 21)
Tests	All tests in A.6

2.7 Temporal

Table 6 — Temporal conformance class

Conformance class	/conf/temporal
Dependency	/conf/uml (2.3)
Requirements	/req/temporal (8.6, Table 23)
Tests	All tests in A.7

2.8 Spatial

Table 7 — Spatial conformance class

Conformance class	/conf/spatial
Dependency	/conf/uml (2.3)
Requirements	/req/spatial (8.7, Table 25)
Tests	All tests in A.8

2.9 Coverages

Table 8 — Coverages conformance class

Conformance class	/conf/coverage
Dependency	/conf/uml (2.3)
Requirements	/req/coverage (8.8, Table 27)
Tests	All tests in A.9

2.10 Observations

Table 9 — Observations conformance class

Conformance class	/conf/observation
Dependency	/conf/uml (2.3)
Requirements	/req/observation (8.9, Table 29)
Tests	All tests in A.10

2.11 Spatial referencing by identifiers

Table 10 — Spatial referencing by identifiers conformance class

Conformance class	/conf/identifier
Dependency	/conf/uml (2.3)
Requirements	/req/identifier (8.10, Table 30)
Tests	All tests in A.11

2.12 Code list

Table 11 — Code list conformance class

Conformance class	/conf/codeList
Dependency	/conf/uml (2.3)
Requirements	/req/codeList (8.11, Table 31)
Tests	All tests in A.12

2.13 Multi-lingual support

Table 12 — Multi-lingual support conformance class

Conformance class	/conf/multi-lingual
Dependency	/conf/uml (2.3)
Requirements	/req/multi-lingual (8.12, Table 32)
Tests	All tests in A.13

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.

IETF RFC 5646 (2009), *Tags for Identifying Languages*, available at <<https://www.rfc-editor.org/info/rfc5646>>

ISO 19103:2015, *Geographic information — Conceptual schema language*

ISO 19107:2003, *Geographic information — Spatial schema*

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

ISO 19112:2003, *Geographic information — Spatial referencing by geographic identifiers*

ISO 19115-1:2014, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 19115-2:2009, *Geographic information — Metadata — Part 2: Extensions for imagery and gridded data*

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

ISO 19156:2011, *Geographic information — Observations and measurements*

ISO 19157:2013, *Geographic information — Data quality*

ISO/IEC 19505-2:2012, *Information technology — Object Management Group Unified Modeling Language (OMG UML) — Part 2: Superstructure*

4 Terms and definitions

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

4.1 application

manipulation and processing of data in support of user requirements

[SOURCE: ISO 19101-1:2014, 4.1.1]

4.2 application schema

conceptual schema (4.5) for data required by one or more *applications* (4.1)

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

4.3 complex feature

feature (4.9) composed of other features

4.4

conceptual model

model (4.15) that defines concepts of a *universe of discourse* (4.19)

[SOURCE: ISO 19101-1:2014, 4.1.5]

4.5

conceptual schema

formal description of a *conceptual model* (4.4)

[SOURCE: ISO 19101-1:2014, 4.1.6]

4.6

coverage

feature (4.9) that acts as a function to return *values* (4.20) from its range for any direct position within its spatial, temporal or spatiotemporal *domain* (4.8)

[SOURCE: ISO 19123:2005, 4.1.7]

4.7

dataset

identifiable collection of data

[SOURCE: ISO 19115-1:2014, 4.3]

4.8

domain

well-defined set

Note 1 to entry: Well-defined means that the definition is both necessary and sufficient, as everything that satisfies the definition is in the set and everything that does not satisfy the definition is necessarily outside the set.

4.9

feature

abstraction of real-world phenomena

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

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

4.10

feature association

relationship that links instances of one *feature* (4.9) type with instances of the same or a different feature type

[SOURCE: ISO 19110:2005, 4.2]

4.11

feature attribute

characteristic of a *feature* (4.9)

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

Note 2 to entry: A feature attribute type has a name, a data type and a *domain* (4.8) associated with it. A feature attribute instance has an attribute *value* (4.20) taken from the domain of the feature attribute type.

[SOURCE: ISO 19101-1:2014, 4.1.12, modified – Notes and examples in 19101-1 have been omitted and other notes have been added.]

4.12

feature operation

operation that every instance of a *feature* (4.9) type may perform

EXAMPLE 1 A feature operation upon the feature type “dam” is to raise the dam. The results of this operation are to raise the height of the “dam” and the level of water in a “reservoir”.

EXAMPLE 2 A feature operation by the feature type “dam” might be to block vessels from navigating along a watercourse.

[SOURCE: ISO 19110:2005, 4.5, modified - The note given in ISO 19110:2005 for this entry has been omitted. A second example has been added.]

4.13

geographic data

data with implicit or explicit reference to a location relative to the Earth

Note 1 to entry: Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.

4.14

metadata

information about a resource

[SOURCE: ISO 19115-1:2014, 4.10]

4.15

model

abstraction of some aspects of reality

4.16

observation

act of measuring or otherwise determining the *value* (4.20) of a *property* (4.17)

[SOURCE: ISO 19156:2011, 4.11]

4.17

property

facet or attribute of an object referenced by a name

[SOURCE: ISO 19143:2010, 4.21]

4.18

quality

degree to which a set of inherent characteristics fulfils requirements

[SOURCE: ISO 9000:2005, 3.1.1]

4.19

universe of discourse

view of the real or hypothetical world that includes everything of interest

[SOURCE: ISO 19101-1:2014, 4.1.38]

4.20

value

element of a type *domain* (4.8)

[SOURCE: ISO/IEC 19501:2005, 0000_5]

5 Presentation and abbreviations

5.1 Presentation

5.1.1 General

This International Standard describes how to create an application schema that integrates conceptual schemas defined in the ISO geographic information standards. In addition to stating the rules for creating application schemas, this International Standard provides guidance through examples.

5.1.2 Conformance class

Conformance to this International Standard is possible at a number of levels, specified by conformance classes ([Clause 2](#)). Each conformance class is summarized using the template shown as [Table 13](#).

Table 13 — Conformance class template

Conformance class	/conf/{classM}
Dependency	[identifier for another conformance class]
Requirements	/req/{classA}
Tests	[reference to clause(s) containing tests]

All tests in a class must be passed, so dependencies are recorded with respect to other conformance classes rather than individual tests. Each conformance class tests conformance to a set of requirements packaged in a requirements class ([Clauses 7 and 8](#)).

5.1.3 Requirements class

Each normative statement (requirement or recommendation) in this International Standard is a member of a requirements class. In this International Standard each requirements class is described in a discrete clause or subclause, and summarized using the template shown as [Table 14](#).

Table 14 — Requirements class template

Requirements class	/req/{classM}
Target type	[artefact or technology type]
Dependency	[identifier for another requirements class]
Requirement	/req/{classM}/{reqN}
Recommendation	/rec/{classM}/{recO}
Requirement	/req/{classM}/{reqP}
Requirement/Recommendation	[repeat as necessary]

All requirements in a class must be satisfied, so the requirements class is the unit of re-use and dependency, rather than individual requirements. Hence, the value of a Dependency requirement is another requirements class.

5.1.4 Rules

All rules are normative, and each rule is presented using the following template:

/re(c q)/[classM]/[reqN]	[Normative statement]
--------------------------	-----------------------

where /re(c|q)/[classM]/[reqN] identifies the requirement or recommendation. The use of this layout convention allows the normative provisions of this International Standard to be easily located by implementers.

5.1.5 Identifiers

Each requirements class, requirement and recommendation has an identifier in the form of a path or partial URI. The identifier supports cross-referencing of class membership, dependencies, and links from each conformance test to requirements tested. The identifier can be appended to a URI that identifies the standard as a whole in order to construct an absolute URI which identifies the requirements class, requirement or recommendation. For example, a URI scheme following the approach described in 2.8 of [IETF RFC 5141] would result in

— <http://standards.iso.org/iso/19109/ed-2>

Hence, the absolute URI for each requirements class would have the form

— [http://standards.iso.org/iso/19109/ed-2/req/\[classM\]](http://standards.iso.org/iso/19109/ed-2/req/[classM])

and the absolute URI for each requirement or recommendation would have the form

— [http://standards.iso.org/iso/19109/ed-2/req/\[classM\]/\[reqN\]](http://standards.iso.org/iso/19109/ed-2/req/[classM]/[reqN])

5.1.6 Conceptual schemas

Conceptual schemas in the normative part of this International Standard are presented in the Unified Modeling Language (UML) in conformance with ISO 19103. UML diagrams are presented in compliance with ISO/IEC 19505-2.

5.1.7 Descriptions of concepts

Concepts from UML are presented in all capitals – e.g. CLASS, PACKAGE, ROLE, ATTRIBUTE, ASSOCIATION.

5.2 Abbreviations

CSL	Conceptual Schema Language
GFM	General Feature Model
OCL	Object Constraint Language
OWL	Web Ontology Language
UML	Unified Modeling Language

5.3 Package abbreviations

Concepts from schemas defined in some other International Standards are designated with names that start with two-letter codes as follow:

CV	ISO 19123:2005 Schema for Coverage Geometry and Functions
DQ	ISO 19157:2013 Data Quality
GM	ISO 19107:2003 Spatial Schema
LI	ISO 19115-2:2009 Metadata extensions for imagery
MD	ISO 19115-1:2014 Metadata fundamentals

MI	ISO 19115-2:2009 Metadata extensions for imagery
OM	ISO 19156:2011 Observations and Measurements
SF	ISO 19156:2011 Observations and Measurements
SI	ISO 19112:2003 Spatial referencing by geographic identifiers
TM	ISO 19108:2002 Temporal Schema, Temporal Objects
TP	ISO 19108:2002 Temporal Schema, Temporal Topology

6 Context

6.1 Purpose of an application schema

An application schema is a conceptual schema for data required by one or more applications. An application schema shall define

- the content and structure of data;
- and may define
- operations for manipulating and processing data;
 - constraints to ensure the integrity of the data.

The purpose of an application schema is twofold:

- to provide a computer-readable data description defining the data structure, which makes it possible to apply automated mechanisms for data management;
- to achieve a common and correct understanding of the data, by documenting the data content of the particular application field, thereby making it possible to unambiguously retrieve information from the data.

6.2 Rules for application schema

This International Standard does not standardize any application schemas; it only defines rules for creating application schemas in a consistent manner (including the consistent definition of features) to facilitate the acquiring, processing, analysing, accessing, presenting and transferring of geographic data between different users, systems and locations. The rules in this International Standard are, in the case of data transfer or interchange, used by suppliers and users of geographic data to

- build a transfer application schema for data interchange;
- interpret the semantics of the transferred dataset with respect to user's local data and content and structure of data;
- determine the necessary transformations between the two datasets.

The rules in this International Standard will assist the users of applications with similar data requirements in creating a common application schema for the interface between their systems and data. This includes an agreement about the elements from the universe of discourse. This is described in more detail in [6.3](#).

The mapping from one application schema to another application schema may be difficult and even impossible if the two schemas are too divergent. The mapping is facilitated if the application schema used within a system is designed considering also the requirements for the data interchange. The rules

can also be used for building an application schema used within a system, although such application schemas are not within the scope of this International Standard.

The creation of an application schema is a process. The content of an application schema has to be settled according to the view of reality in the universe of discourse. This is modelled in terms of types of features and their properties. [Clause 7](#) contains principles for consistently defining features.

The application schema defines the structure and content of data. It is expressed in a conceptual schema language (CSL). [Clause 7](#) also includes a model expressed in a UML profile that defines the concepts required to describe types of features. Feature type definitions may be documented in feature catalogues (ISO 19110). Such definitions may be used in an application schema. Other ISO geographic information standards define reusable modules of conceptual schemas that may be integrated in an application schema. [Clause 8](#) gives the main rules for integrating these predefined modules into a conceptual schema in UML.

NOTE ISO 19118, ISO 19136 and ISO/TS 19139 define how a dataset defined by an application schema in UML is encoded.

6.3 Application schema supporting data interchange

6.3.1 Introduction

Data interchange between information systems may take place in two ways:

- In the traditional data transfer model, the data supplier creates a dataset that is transferred to the user. The structure and the content of data are described in the application schema for the dataset. The dataset is sent in a transfer format;
- In the interoperability model, the user application communicates with the supplier application through a common communication protocol. In this scenario, the user invokes services that result in data being passed from the service provider to the user application. The application schema describes not only the structure and content of the exchanged data, but also the structure of the interfaces involved in the transaction.

There is a fundamental distinction between a data transfer and a data transaction. In data transfer, a data set is predefined in an application schema. The spatial extent and the rules for inclusion of feature instances are also predefined. The user requests and receives a copy of the dataset (or may receive it automatically through a long-term agreement for distribution of datasets). In a data transaction, a requester first specifies selection criteria, such as spatial extent and feature instance inclusion rules for the data from the producer's data store. Data meeting the selection criteria are then retrieved from the data store and provided to the user.

NOTE Conformance to the rules in this International Standard does not guarantee that data conforming to any given application schema can be transformed in a meaningful way to conform to any other application schema. At best, it allows the user to determine which elements are common to the two schemas and which could be transformed from one schema to another, as well as those that cannot be transformed. Complete interoperability can only occur when user and supplier have identical application schemas.

6.3.2 Data interchange by transfer

[Figure 1](#) shows the traditional data transfer model for data suppliers and data users. The structure and content of the data provided by the supplier and received by the user are described in application schemas. To be able to transfer data, three conditions must be fulfilled.

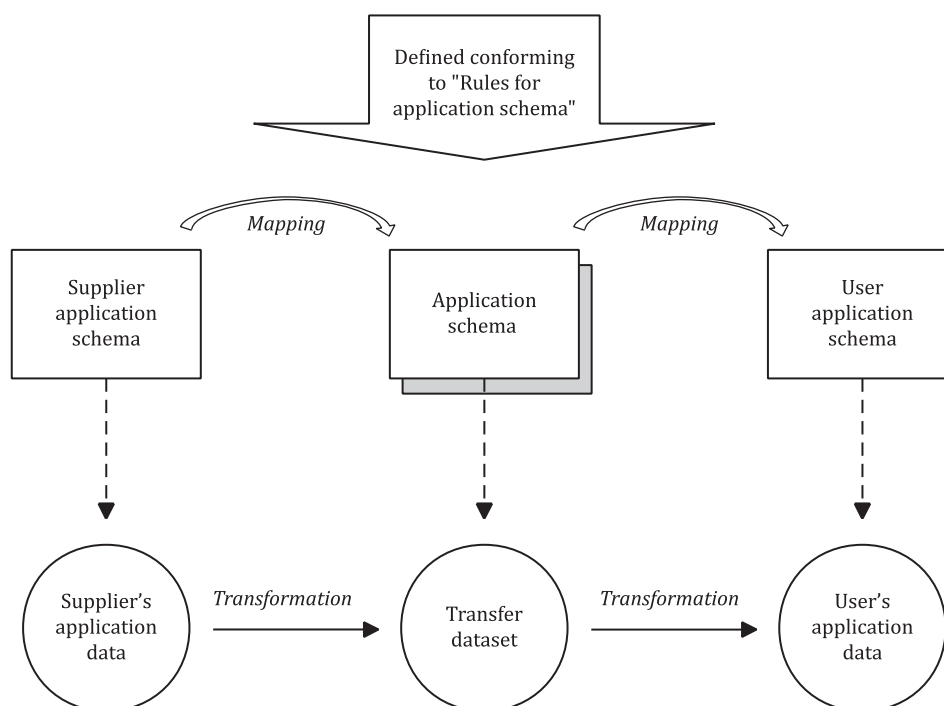


Figure 1 — Data interchange by transfer

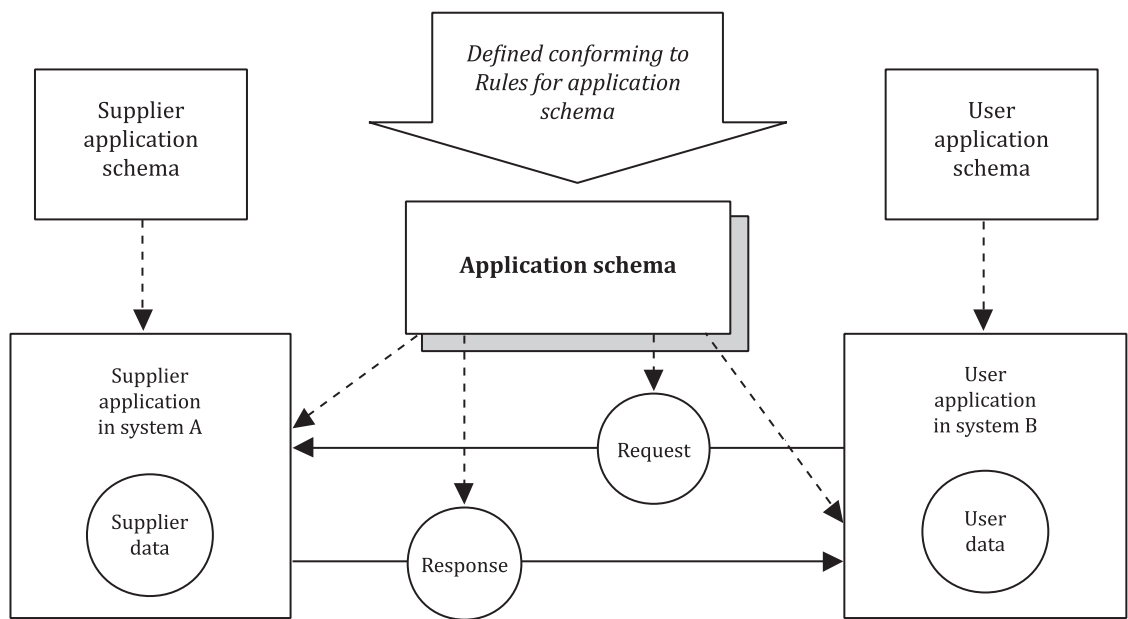
First, the user and the supplier must agree on creating an application schema for the data being exchanged in accordance with this International Standard. In order to facilitate the transfer of data, the application schema is developed using the application schemas from the user and the supplier. One mapping will be made from the supplier's application schema to this application schema for the exchanged data, and a second mapping will be made from this application schema to the application schema of the user.

Second, the supplier must be able to transform the application data defined according to the supplier application schema into a transfer dataset defined according to the application schema for the exchanged data.

Third, the user must be able to transform the transfer dataset defined according to its application schema to the application data defined according to the user's application schema.

6.3.3 Data interchange by transactions

Figure 2 shows data interchange through transactions described in the interoperability model. The user application makes a request for data that is received by the supplier application. In response, the supplier application delivers a resulting dataset. Both the request and the resulting dataset are defined according to a common application schema. The supplier application is responsible for transforming the data in system A into the data in the exchanged dataset. After receipt, the user application is responsible for transforming the exchanged data into data in system B. Data interchange by transaction is provided by geospatial services as defined in ISO 19119. In particular, feature access services are defined in Geographic model/information management services.



NOTE The unbroken lines show the flow of data. Broken lines denote the role of the application schema on the data interchange.

Figure 2 — Data interchange by transactions

7 Principles for defining features

7.1 General

This clause describes general rules for formalizing an application schema, independent of any specific conceptual schema language. The General Feature Model is the meta-model for application schemas, and the definition of the General Feature Model is part of the general rules. The rules comprise a requirements class summarized in [Table 15](#).

Table 15 — Requirements class covering general requirements and the meta-model for application schemas

Requirements class	/req/general
Target type	Application schema
Requirement	/req/general/csl
Requirement	/req/general/integration
Requirement	/req/general/feature
Recommendation	/rec/general/property-name
Requirement	/req/general/attribute
Requirement	/req/general/operation
Requirement	/req/general/association-role
Requirement	/req/general/value-assignment
Requirement	/req/general/feature-association
Requirement	/req/general/inheritance
Recommendation	/rec/general/constraint

7.2 Features, Coverages and Properties

7.2.1 Features

A fundamental unit of geographic information is called a feature. ISO 19110 provides a standard framework for organizing and reporting the classification of features.

This International Standard gives rules for creating application schemas, including the principles for the definition of features. The term “feature” is used in different contexts, and defined according to the four-layer architecture. [Annex B](#) describes the use of the term feature in the four-layer architecture.

This International Standard distinguishes four aspects of defining features: the definitions or description used to group them into types, the attributes associated with each type, the relationships among the types and the behaviour of the features.

EXAMPLE “Tower Bridge” is the abstraction of a certain real-world bridge in London. The term “bridge” is the abstraction of the collection of all real-world phenomena that is classified into the concept behind the term “bridge”. Later in the document, the terms “feature type” and “feature instance” are used to separate the concept of “feature” describing the whole collection from the concept of describing a certain instance occurrence.

[Figure 3](#) describes the most abstract level of defining and structuring geographic data. The classification of real-world phenomena as features depends on their significance to a particular universe of discourse.

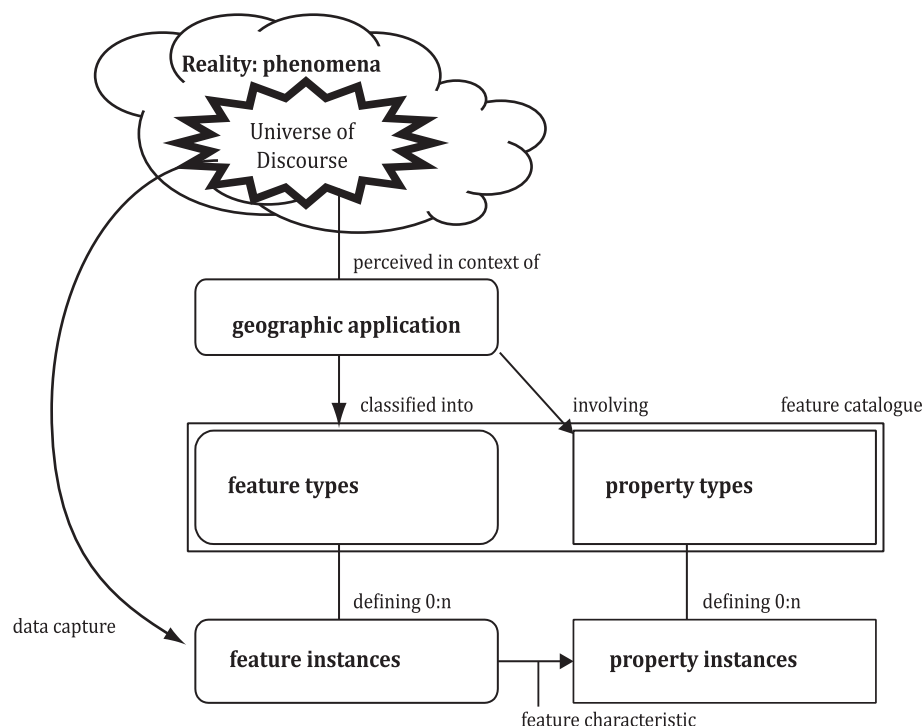


Figure 3 — The process from universe of discourse to data

7.2.2 Coverages

Many aspects of the real-world may be represented as features whose properties are single-valued and static. These conventional features provide a model of the world in terms of discrete objects located in it. However, in some applications it is more useful to use a model focussing on the variation of property values in space and time, formalized as coverages. Users of geographic information may utilize both viewpoints. While coverages are themselves strictly features as well, it is common to contrast coverages and non-coverage features when discussing the functionality provided by each viewpoint. In the following discussion the name ‘feature’ refers to non-coverage features.

The feature and coverage representations may be related in several ways:

- signal processing to find and characterize features: signals in coverages may provide evidence for the existence, location and type of features, detected through modelling and interpretation;

EXAMPLE 1 Patterns of colour or other radiance bands within a remotely-sensed image may be used to infer the existence of specific objects or features on the ground.

EXAMPLE 2 Signals in a geophysical borehole log may be used to infer the presence of particular rock-units at underground locations.

- coverage-typed feature properties: feature properties whose value vary within the scope of a feature may be described as coverages whose domain extent is the geometry of the feature;

EXAMPLE 3 The variation of concentration of a particular ore-mineral within a mine may be described as a spatial function or coverage within the spatial limits of the mine.

- features sample a coverage: the values of a common property of a set of features provide a discrete sampling of a coverage, whose range type is the property, and whose domain is the aggregate geometry of the set of features.

EXAMPLE 4 The temperature at a set of weather stations may be compiled to show the spatial variation of temperature across the region where the stations are located.

A constraint in the latter two cases is that a property-type from a feature catalogue is the range-type of a coverage description in the same universe of discourse.

The case of features having property values that vary within the scope of the feature can be described using the general feature model (7.5.8).

While the coverage model is described in detail in ISO 19123, an application schema may include both feature- and coverage-types.

NOTE The feature and coverage viewpoints are related to (though not identical with) the so-called ‘vector’ and ‘raster’ approaches from traditional GIS implementations.

7.2.3 Properties and observations

Property values are associated with features and coverages. In the case of features, a property value is associated with a classified object. In the case of coverages, a property value is associated with a position in the domain.

Property values can be assigned in a number ways, such as through assertion by a competent authority, by inheritance from a parent feature or type, by derivation from more primitive properties, or by observation. In the latter case the value assigned is an estimate, with an error resulting from the observation procedure.

NOTE Following ISO 19156, ‘observation’ denotes the generalized case of an event using a procedure to generate the estimate. The procedure may involve a sensor, but may also be a computational or classification process.

The result of an observation is a property value that is assigned to its feature of interest. Where the feature property has a constant value, an associated observation result has a static value. Where the feature property varies with position, the result of an associated observation is a spatial function or coverage.

7.3 Features and the application schema

This International Standard supports the definition of feature types and coverages with respect to their representation in data structures defined by application schemas.

Figure 4 shows the process of structuring data from the universe of discourse to the geographic dataset. The definitions of the feature types and their properties, as perceived in context of an application field, will be derived from the universe of discourse. A feature catalogue documents the feature types.

An application schema defines the logical structure of data and may define operations that can be performed on or with the data. An application schema addresses the logical organization, rather than the physical. An application schema is formalized using a Conceptual Schema Language.

/req/general/csl	An application schema shall be expressed in a conceptual schema language. It shall describe the structure and content of the dataset that represents a universe of discourse.
------------------	---

When creating an application schema, the concepts of the General Feature Model (GFM; see 7.4) are mapped to the concepts of the chosen conceptual schema language. For UML, these rules are described in [Clause 8](#).

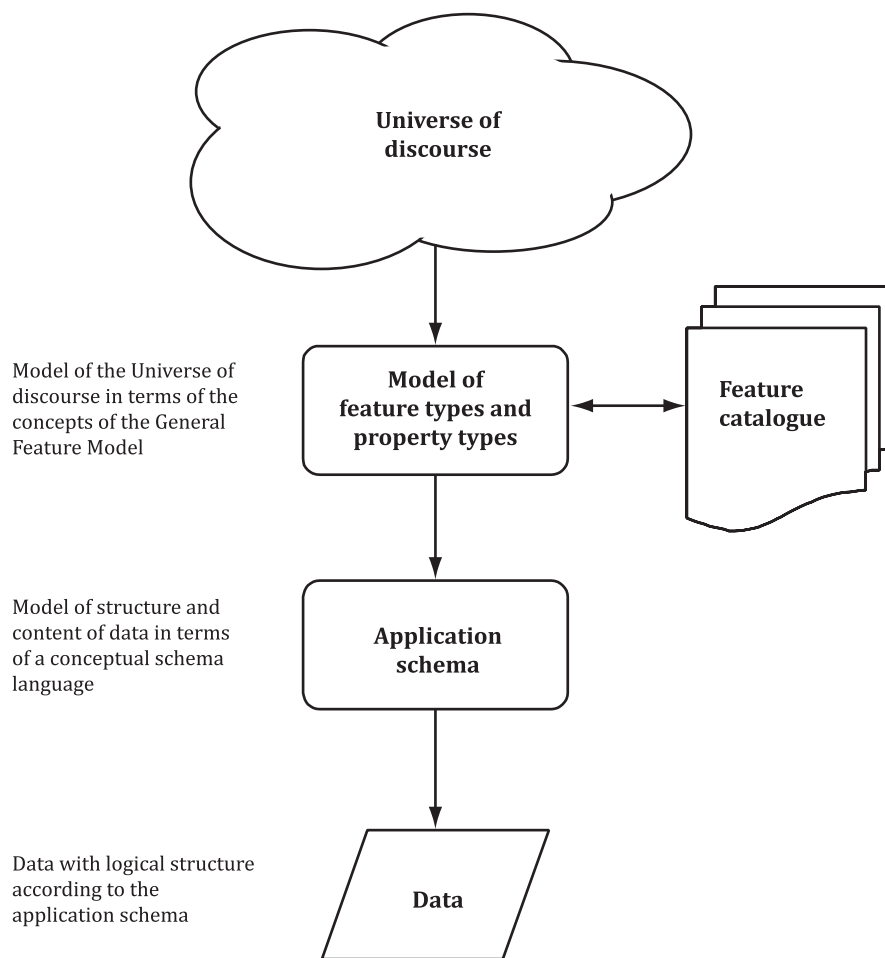


Figure 4 — From reality to geographic data

Use of definitions from existing feature catalogues or feature concept dictionaries can reduce the costs of data acquisition, allowing developers to use existing data, and simplify the process of developing the application schema. Dependencies are clearly recorded.

/req/general/integration	The developer of an application schema may use definitions from feature catalogues that already exist. Where an application schema integrates components from another schema, the dependencies shall be recorded explicitly using mechanisms provided by the conceptual schema language.
--------------------------	--

7.4 The General Feature Model

7.4.1 Introduction

Concepts used to define features and how these concepts are related are identified and described in [7.4](#). The description is expressed in a conceptual model, also called the General Feature Model (GFM).

[Annex B](#) provides discussions regarding the purpose and design of the GFM.

NOTE The complete kernel of GFM is found in Annex B.3.

[7.5](#) to [7.7](#) depict how different aspects of the properties of a feature are managed. [7.5](#) describes different aspects of attributes and [7.6](#) describes different aspects of relationships. [7.7](#) describes the concept of constraints.

7.4.2 The purpose of the GFM

The GFM is a model of the concepts required to classify a view of the real world. It is expressed in a CSL, which is UML in accordance with ISO 19103.

The things we want to classify are called features. Feature types have properties that are feature attributes, feature operations and feature association roles. The relations between feature types are feature associations and inheritance. All these concepts are expressed as metaclasses in the GFM. The GFM is a metamodel of feature types.

Feature types can be documented in feature catalogues. The GFM may serve as the conceptual model of the structure of a feature catalogue, but the feature catalogue has additional concepts for documenting feature types. There is a Feature Catalogue Model (FCM) that realizes the GFM concepts and adds more concepts (see ISO 19110). Some new concepts are, for example, a list of the feature attributes of each feature type, aliases of the feature type name, and codes for the feature type name. These additional concepts are not in conflict with the concepts from the GFM.

The GFM specifies the requirements for the classification of features, but is not a CSL. We have to use an existing CSL to define the application schema. Within the ISO geographic information standards, UML is used to define standard schemas. As we want to integrate standard schemas into our application schemas, it is convenient to also express the application schema in UML. This International Standard defines the main rules for mapping GFM concepts into UML. This may be done for other CSLs as well. As UML provides a general mechanism for classifications of any kind, it has to be profiled to be used as a basis for the classification of features. This profile is UML as specified in ISO 19103 and augmented in this International Standard and is summarized in [8.2.2](#).

The GFM defines the structure for classifying features that we need to keep in mind when we make our application schema in UML. However, the mapping from GFM to UML is a one-way mapping; it is not possible to map backwards. For example, the application schema has UML classes. Some of these classes are GFM feature types and some are the datatypes for feature attributes; it is not possible to keep these things apart. The GFM does not define feature-attribute values to the depth that is needed. That is not necessary to do as the GFM only specifies the structure and content of definition of features.

Hence, the GFM is a metamodel for definition of features that is also used to define the structure of feature catalogues. The chosen CSL (i.e. the UML profile as restricted by ISO 19103 and augmented in this International Standard) is the metamodel for an application schema.

7.4.3 The main structure of the GFM

[Figure 5](#) shows the concepts used to define types of features. Besides a name and a description, a feature type is defined by its properties such as

- feature attributes,
- feature association roles characterizing the feature type, and

- defined behaviour of the feature type.

Additional concepts are

- feature associations between the feature type and itself or other feature types,
- generalization and specialization relationships to other feature types, and
- constraints on the feature type.

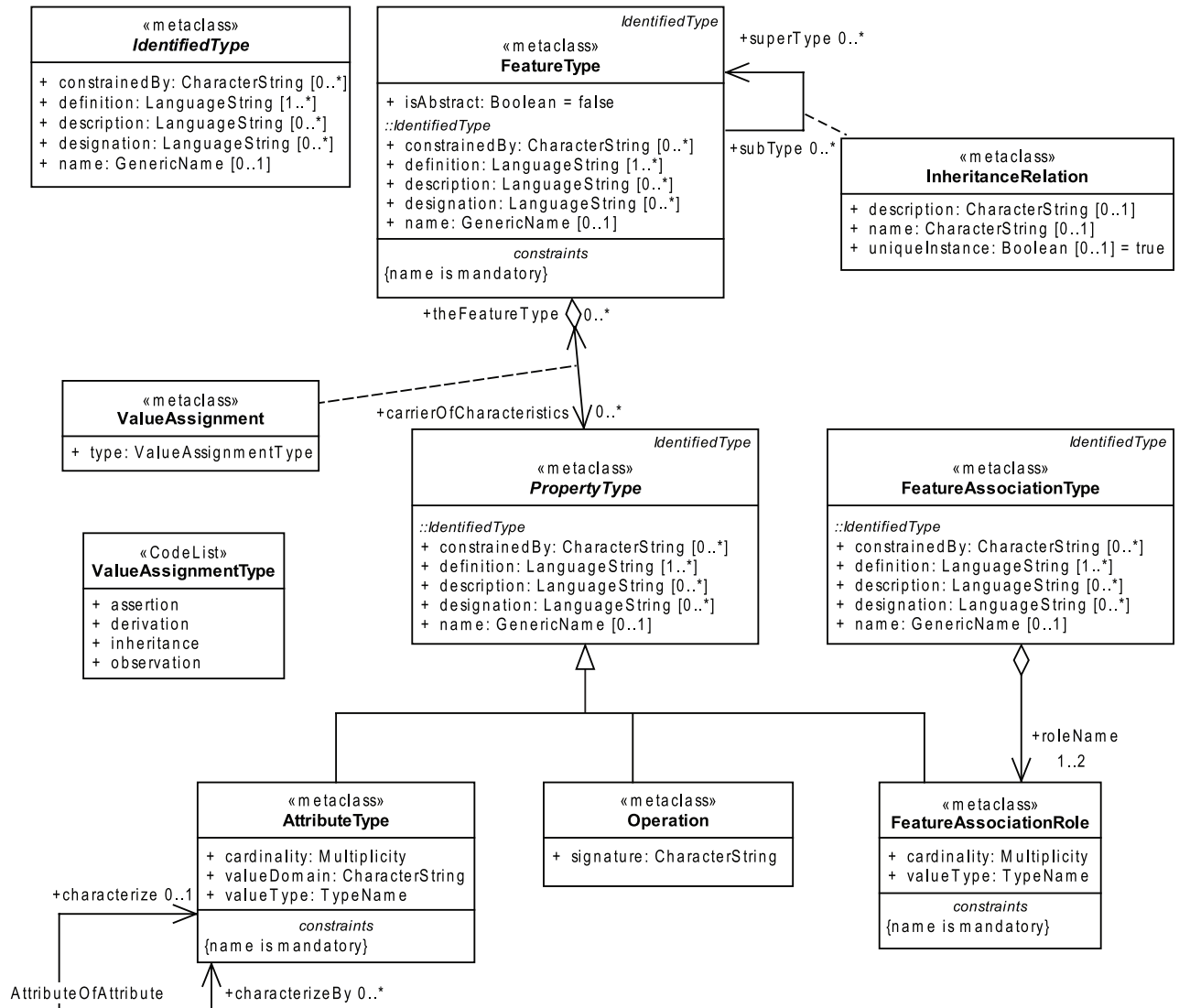


Figure 5 — The General Feature Model

NOTE 1 Earlier versions of this standard prefixed most class names with 'GF_'. That convention is no longer used.

NOTE 2 The types CharacterString, GenericName, LanguageString, LocalName, TypeName, are from ISO 19103.

7.4.4 IdentifiedType

IdentifiedType is a metaclass from which the other key classes in the General Feature Model inherit some common identification and description attributes. IdentifiedType is the supertype of FeatureType, PropertyType and FeatureAssociationType.

— name

name of the element. Optional in general, but required on some specializations as indicated below. The type GenericName [ISO 19103] allows the namespace to be either explicit or implicit.

The CSL may constrain the scope and namespace of model elements. In UML the name of a class is scoped to the package, and the name of an attribute or role is scoped to a class, so when using UML as the CSL [Clause 8] the Application Schema provides the namespace for feature types, and the feature type provides the namespace for properties. In OWL the namespace for both classes and properties is usually but not necessarily provided by the ontology. When using OWL as the CSL [ISO 19150-2] classes will typically be scoped to the ontology or application schema, but property types may be scoped to a class, to the application schema, or to an external ontology or catalogue.

— definition

concise definition of the element. One definition is mandatory. Additional definitions can be provided in multiple languages if required.

— designation

natural language designator for the element to complement the **name**. Optional, with multiple designations allowed to support different languages.

— description

description of the element, including information beyond that required for concise definition but which may assist in understanding its scope and application. Optional, with multiple descriptions allowed to support different languages.

— constrainedBy

description of a constraint made on the IdentifiedType or specified on properties within a type. Also see 7.7.

7.4.5 FeatureType

A feature is an abstraction of real-world phenomena. FeatureType is a metaclass that is instantiated as classes that represent individual feature types. A certain feature type is the class for all instances of that feature type. The instances of a class that represents an individual feature type are feature instances.

/req/general/feature	Features shall be modelled as instances of the metaclass FeatureType, as defined in Figure 5 and in 7.4.5. Features shall not be modelled as specializations of GM_Object (ISO 19107:2003) or TM_Object (ISO 19108:2002). The feature shall have a name that is unique in the application schema.
----------------------	--

NOTE 1 Feature types are equivalent to classes and feature instances are equivalent to objects, in object-oriented modelling.

NOTE 2 Geometry-, topology- and temporal-objects (GM_Object, TP_Object, TM_Object) are not abstractions of real-world phenomena. These types can provide types for feature properties, but cannot be specialized to features.

NOTE 3 Annex B provides a table on the use of the term “feature”.