INTERNATIONAL STANDARD

ISO 19109

First edition
2005-06-15

Geographic information — Rules for application schema

Information géographique — Règles de schéma d'application

Reference number
ISO 19109:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 19109 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

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.

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

Any application schema claiming conformance to this International Standard shall pass all of the requirements described in the abstract test suites in Annex A.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 19103:—[1)], *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 19113:2002, *Geographic information — Quality principles*

ISO 19115:2003, *Geographic information — Metadata*

ISO/IEC 19501, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

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

[ISO 19101]

4.2
application schema
conceptual schema for data required by one or more applications

[ISO 19101]

4.3
complex feature
feature composed of other features

4.4
conceptual model
model that defines concepts of a universe of discourse

[ISO 19101]

4.5
conceptual schema
formal description of a conceptual model

[ISO 19101]

1) To be published.

4.6
dataset
identifiable collection of data

[ISO 19115]

4.7
domain
well-defined set

[ISO 19107]

NOTE 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.

4.8
feature
abstraction of real-world phenomena

NOTE A feature may occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

[ISO 19101]

4.9
feature association
relationship that links instances of one feature type with instances of the same or a different feature type

[ISO 19110]

4.10
feature attribute
characteristic of a feature

NOTE 1 A feature attribute may occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.

NOTE 2 A feature attribute type has a name, a data type and a domain associated to it. A feature attribute instance has an attribute value taken from the domain of the feature attribute type.

[adapted from ISO 19101]

4.11
feature operation
operation that every instance of a feature 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.

[adapted from ISO 19110]

4.12
geographic data
data with implicit or explicit reference to a location relative to the earth

NOTE Geographic information is also used as a term for information concerning phenomena implicitly or explicitly associated with a location relative to the earth.

4.13
metadata
data about data

[ISO 19115]

4.14
model
abstraction of some aspects of reality

4.15
portrayal
presentation of information to humans

[ISO 19117]

4.16
quality
totality of characteristics of a product that bear on its ability to satisfy stated and implied needs

[ISO 19101]

4.17
universe of discourse
view of the real or hypothetical world that includes everything of interest

[ISO 19101]

5 Presentation and abbreviations

5.1 Presentation

This International Standard describes how to create an application schema that integrates conceptual schemas defined in the ISO 19100 series of International Standards for geographic information. In addition to stating the rules for creating application schemas, this International Standard provides guidance through examples. This International Standard adopts the following conventions for presentation purposes:

a) Rules:

All rules are normative, and are described as follows.

Rules:

1) <Rule 1>

2) <Rule 2>

b) Tables:

Tables that are not referenced from the rules are informative.

c) Conceptual schemas:

Conceptual schemas in the normative part of this International Standard are presented in the Unified Modelling Language (UML) in conformance with ISO/TS 19103. UML diagrams are presented in compliance with ISO/IEC 19501.

5.2 Abbreviations

CSL Conceptual schema language

GFM General feature model

OCL Object constraint language

UML Unified modelling language

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 defines

— content and structure of data; and

— specifications of operations for manipulating and processing data by an application.

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; and

— 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 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; and

— 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 UML that defines the concepts required to describe types of features. Feature type definition may be documented in feature catalogues. Such definitions may be used in an applications schema. Other standards in the ISO 19100 series 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 defines 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.

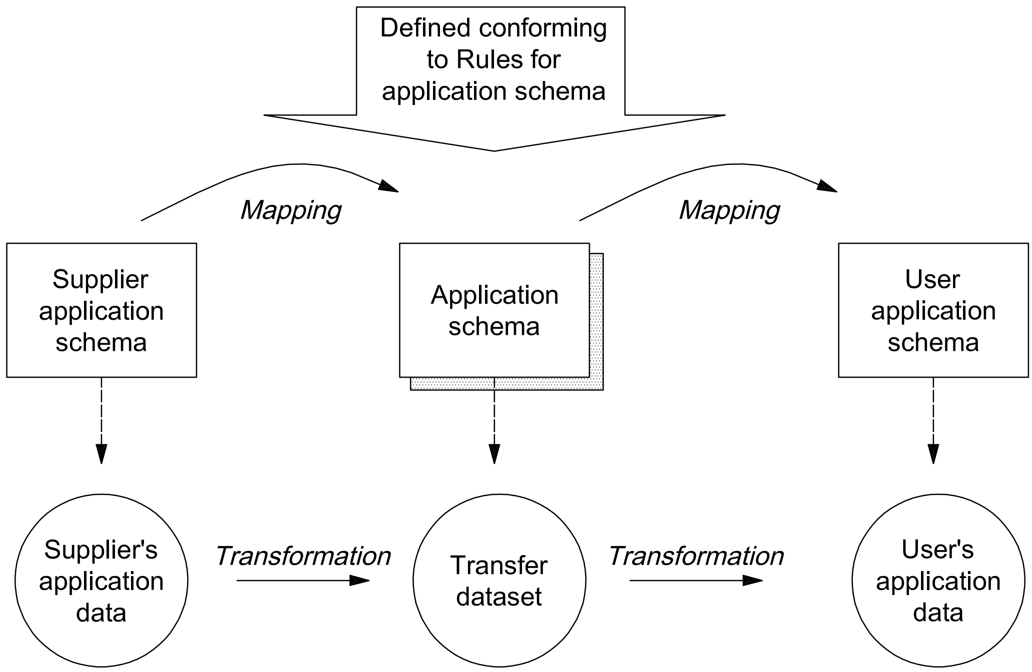


Figure 1 — Data interchange by transfer

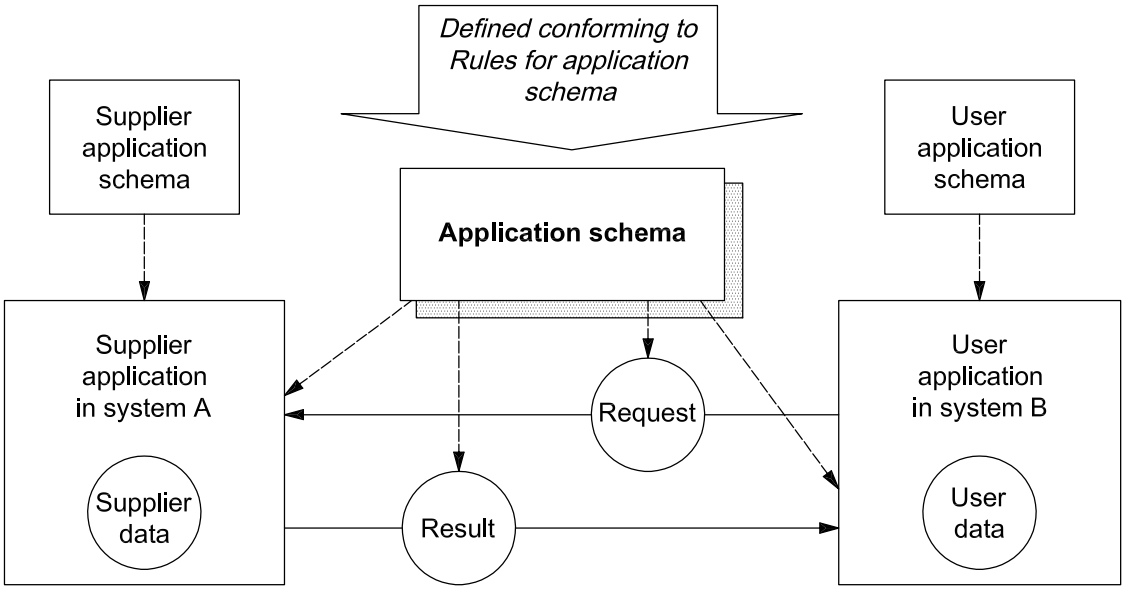
First, the user and the supplier must agree on creating an application schema for the data being exchanged in accordance with this International Standard. In order to facilitate the transfer of data, this application schema shall be developed using the application schemas from the user and the supplier. 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 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. It also gives a broader discussion on different aspects of geographic 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 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.

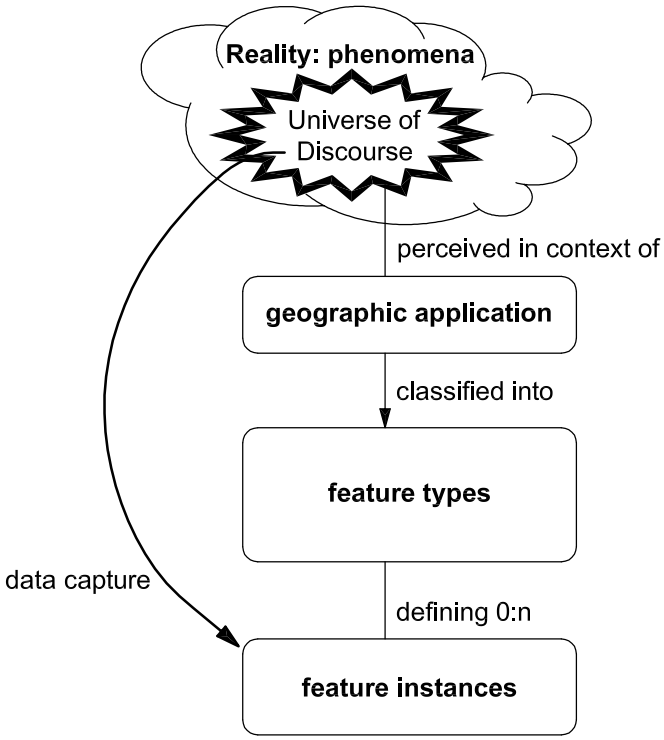


Figure 3 — The process from universe of discourse to data

7.2 Features and the application schema

This International Standard supports the definition of features 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.

The developer of an application schema may use feature definitions from feature catalogues that already exist. This will reduce the costs of data acquisition, allowing the developer to use existing data, and simplify the process of developing the application schema.

The application schema shall be expressed in a conceptual schema language. Each conceptual schema language has its own terms and concepts. When creating an application schema, the concepts of the General Feature Model (GFM; see 7.3) are mapped to the concepts of the chosen conceptual schema language. For UML, these rules are described in 8.3.

NOTE Annex C gives as an example the rules for mapping the concepts of the GFM to the concepts of ISO 10303-11.