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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).

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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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Intelligent transport systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement), and in collaboration with the Open Geospatial Consortium (OGC).

This second edition cancels and replaces the first edition (ISO 19156:2011), which has been technically revised.

The main changes are as follows:

— the UML model and the requirements/conformance class structure has been completely redesigned to address the contemporary modelling and observation data provision use cases;

— the fundamental Observation model has remained largely the same as in ISO 19156:2011, but certain carefully designed improvements and clarifications for the intended use have been included;

— the Sample model has been refined: given the integral nature of the Sample model, is has been decided to include that term in the name of the document;

— Annex C has been added listing the technical changes in the Observation and Sample models between ISO 19156:2011 and this document.

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

This document arises from work originally undertaken through the Open Geospatial Consortium's Sensor Web Enablement (SWE) activity. A set of interfaces and protocols was standardized through which applications and services are able to access sensors of all types, and observations generated by them, over the Web.

A new generation of geospatial standards is now emerging, based on general Web standards, architecture and current practice, as described in W3C Spatial Data on the Web Best Practices.[31] This includes several new standards for describing and publishing sensors and observations, such as the OGC SensorThings API[22] and the W3C/OGC Semantic Sensor Network Ontology.[28] This second edition of ISO 19156 (now named "Observations, Measurements and Samples", or abbreviated to "OMS") is informed by these recent developments. The focus of revising ISO 19156:2011 is aimed at enabling the publication of observation data as part of the Web of data, while also supporting other means of data exchange.

The content presented in this document is derived from the previous edition published by Open Geospatial Consortium as OGC 10-004r3, and also ISO 19156:2011. A technical note describing the changes in comparison to ISO 19156:2011 is provided in Annex C.

The name and contact information of the maintenance agency for this document can be found at www.iso.org/maintenance_agencies.

Geographic information — Observations, measurements and samples

1 Scope

This document defines a conceptual schema for observations, for features involved in the observation process, and for features involved in sampling when making observations. These provide models for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities.

Observations commonly involve sampling of an ultimate feature-of-interest. This document defines a common set of sample types according to their spatial, material (for ex situ observations) or statistical nature. The schema includes relationships between sample features (sub-sampling, derived samples).

This document concerns only externally visible interfaces and places no restriction on the underlying implementations other than what is needed to satisfy the interface specifications in the actual situation.

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 19103, *Geographic information — Conceptual schema language*

ISO 19107, *Geographic information — Spatial schema*

ISO 19108, *Geographic information — Temporal schema*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
application schema
conceptual schema for data required by one or more applications

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

3.2
coverage
feature that acts as a function to return values from its range for any direct position within its domain

[SOURCE: ISO 19123-1:—,[1] 3.1.8]

1) Under preparation. Stage at the time of publication: ISO/FDIS 19123-1:2022.

3.3
data type
specification of a value domain with operations allowed on values in this domain

EXAMPLE Integer, Real, Boolean, String and Date.

Note 1 to entry: Data types include primitive predefined types and user-definable types.

[SOURCE: ISO 19103:2015, 4.14]

3.4
domain
well-defined set

Note 1 to entry: All elements within a domain (set) are of a given type.

[SOURCE: ISO 19109:2015, 4.8, modified — Original Note 1 to entry has been replaced with a new Note 1 to entry.]

3.5
domain feature
feature of a type defined within a particular application domain

Note 1 to entry: This can be contrasted with observations and sampling features, which are features of types defined for cross-domain purposes.

3.6
ex situ
off-site
referring to the study, maintenance or conservation of a specimen or population away from its natural surroundings

Note 1 to entry: Opposite of in situ (on-site).

Note 2 to entry: An example of ex situ and direct is measuring a patient's temperature with a mercury thermometer in a blood sample.

Note 3 to entry: An example of ex situ and remote is measuring a patient's temperature with an infra-red thermometer pointed at the blood sample.

3.7
feature
abstraction of real-world phenomena

Note 1 to entry: A feature can occur as a type or an instance. In this document, feature instance is meant unless otherwise specified.

[SOURCE: ISO 19101-1:2014, 4.1.11, modified — Note 1 to entry has been modified.]

3.8
feature-of-interest
subject of the observation

3.9
feature type
class of features having common characteristics

3.10
in situ
on-site
referring to the study, maintenance or conservation of a specimen or population without removing it from its natural surroundings

Note 1 to entry: Opposite of ex situ (off-site).

Note 2 to entry: An example of in situ and direct is measuring a patient's temperature with a mercury thermometer in the patient's rectum.

Note 3 to entry: An example of in situ and remote is measuring a patient's temperature with an infra-red thermometer at a distance.

3.11
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.

[SOURCE: ISO 19136-1:2020, 3.1.41]

3.12
measurement
set of operations having the object of determining the value of a quantity

[SOURCE: ISO 19101-2:2018, 3.21]

3.13
observation
act carried out by an observer to determine the value of an observable property of an object (feature-of-interest) by using a procedure, with the value provided as the result

3.14
observation result
estimate of the value of a property determined through a known observation procedure

3.15
observer
identifiable entity that can generate observations pertaining to an observable property by implementing a procedure

Note 1 to entry: An observer is an instance of a sensor, instrument, implementation of an algorithm or a being such as a person.

3.16
procedure
specified way to carry out an activity or a process

[SOURCE: ISO 9000:2015, 3.4.5, modified — Note 1 to entry has been deleted.]

3.17
process
set of interrelated or interacting activities that use inputs to deliver an intended result

[SOURCE: ISO 9000:2015, 3.4.1, modified — Notes 1-6 have been deleted.]

3.18
property
facet or attribute of an object referenced by a name

EXAMPLE Abby's car has the colour red, where "colour red" is a property of the car.

Note 1 to entry: In some communities, the observed property is referred to as the measurand.

[SOURCE: ISO 19143:2010, 4.21, modified — Example and note have been added to the entry.]

3.19
property type
characteristic of a feature type

EXAMPLE Cars (a feature type) all have a characteristic colour, where “colour” is a property type.

Note 1 to entry: The value for an instance of an observable property type can be estimated through an act of observation.

Note 2 to entry: In chemistry-related applications, the term “determinand” or “analyte” is often used.

3.20
proximate feature-of-interest
entity that is directly of interest in the act of observing

Note 1 to entry: This is a specialized form of the feature-of-interest.

3.21
range
<coverage> set of feature attribute values associated by a function, the coverage, with the elements of the domain of a coverage

Note 1 to entry: This is consistent with the more generic definition of "range" in ISO 19107.

[SOURCE: ISO 19123-1:—, 3.1.47]

3.22
sample
object that is representative of a concept, real-world object or phenomenon

3.23
sampler
device or entity (including humans) that is used by, or implements, a sampling procedure to create or transform one or more sample(s)

3.24
sensor
element of a measuring system that is directly affected by a phenomenon, body, or substance carrying a quantity to be measured

[SOURCE: JCGM 200:2012, 3.8, modified — EXAMPLES and NOTE deleted.]

3.25
ultimate feature-of-interest
entity that is ultimately of interest in the act of observing

Note 1 to entry: This is a specialized form of the feature-of-interest.

3.26
unit of measure
reference quantity chosen from a unit equivalence group

Note 1 to entry: In positioning services, the usual units of measurement are either angular units or linear units. Implementations of positioning services shall clearly distinguish between SI units and non-SI units. When non-SI units are employed, it is required that their relation to SI units be specified.

[SOURCE: ISO 19116:2019, 3.29]

3.27
value
element of a type domain

Note 1 to entry: A value considers a possible state of an object within a class or type (domain).

Note 2 to entry: A data value is an instance of a datatype, a value without identity.

Note 3 to entry: A value can use one of a variety of scales including nominal, ordinal, ratio and interval, spatial and temporal. Primitive datatypes can be combined to form aggregate datatypes with aggregate values, including vectors, tensors and images.

[SOURCE: ISO/IEC 19501:2005, 0000_5, modified — Notes 1- 3 to entry have been added.]

4 Document conventions

4.1 Abbreviated terms and acronyms

CIS	Coverage Implementation Schema
EO	Earth observation
GFM	general feature model
GML	Geography Markup Language
INSPIRE	Infrastructure for Spatial Information in Europe
O&M	observations and measurements
OMS	observations, measurements and samples (this document)
OGC	Open Geospatial Consortium
RDA	Research Data Alliance
SensorML	OGC Sensor Model Language
SOS	OGC Sensor Observation Service
STA	OGC SensorThings API
SWE	OGC Sensor Web Enablement
UML	Unified Modeling Language
UoM	unit of measure
URI	Uniform Resource Identifier
XML	Extensible Markup Language
2-D	two-dimensional
3-D	three-dimensional

4.2 Schema language

The conceptual schema specified in this document is in accordance with the Unified Modelling Language (UML, ISO/IEC 19501), following the guidance of ISO 19103.