INTERNATIONAL STANDARD

ISO 19150-4

First edition
2019-05

Geographic information — Ontology —

Part 4: Service ontology

Information géographique — Ontologie —

Partie 4: Ontologie de service

Reference number
ISO 19150-4:2019(E)

© ISO 2019



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

 © ISO 2019 – All rights reserved

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms, definitions, abbreviated terms, and namespaces ... **1**
3.1 Terms and definitions ... 2
3.2 Abbreviated terms ... 5
3.3 Namespaces ... 5
4 Conformance ... **5**
5 GeoWeb service ontology framework ... **6**
5.1 General ... 6
5.2 GeoWeb service identification and description ... 6
5.2.1 General ... 6
5.2.2 GeoWeb service identification ... 8
5.2.3 GeoWeb service description ... 8
5.2.4 Taxonomy and function ... 10
5.2.5 GeoWeb service taxonomy ... 11
5.2.6 GeoWeb service function ... 13
5.2.7 GeoWeb service lifecycle ... 25
5.2.8 Service parameters ... 26
5.2.9 Service cost ... 27
5.3 GeoWeb service capabilities ... 28
5.3.1 General ... 28
5.3.2 GeoWeb service capability ... 29
5.3.3 Accuracy ... 31
5.3.4 Performance ... 31
5.3.5 Security ... 32
5.4 GeoWeb service metadata ... 33
5.4.1 General ... 33
5.4.2 GeoWeb service metadata ... 34
6 OWL ontology of GeoWeb service ... **35**
6.1 General ... 35
6.2 Service requirements ... 35
6.3 Capability requirements ... 36
6.4 Metadata requirements ... 36
Annex A (normative) **Abstract test suite** ... **38**
Annex B (informative) **Use cases** ... **47**
Annex C (informative) **OWL resources** ... **50**
Bibliography ... **51**

© ISO 2019 – All rights reserved

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*.

A list of all parts in the ISO 19150 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.

© ISO 2019 – All rights reserved

Introduction

The Semantic Web has introduced the Web of data. The Web of data is essentially an extension of the Web oriented towards machine-processable data as opposed to documents. It could be seen as a tremendous worldwide open database that people can query from their own perspective, understanding, or abstraction of real-world phenomena or events and get accurate, detailed, and appropriate answers as people communicate between each other. This approach involves reasoning capabilities based on ontologies. The Semantic Web brings new opportunities for the geographic information realm to lay out a new generation of standards in order to benefit from these in achieving semantic interoperability of geographic information.

Fundamentally, ontology comes from philosophy and refers to the study of the nature of the world itself. The information technology and artificial intelligence communities borrowed the term ontology for the explicit specification of a conceptualization[2]. In geographic information, ontology consists of a formal representation of phenomena of a universe of discourse with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships[1]. Information technology and artificial intelligence consider that reality may be abstracted differently depending on the context from which "things" are perceived and, as such, recognize that multiple ontologies about the same part of reality may exist. An ontology can be formalized differently ranging from weak to strong semantics: taxonomy, thesaurus, conceptual model, logical theory[2].

On the Semantic Web, ontology defines the meaning of data and describes it in a format that machines and applications can read. An application using data also has access to their inherent semantics through the ontology associated with it. Ontologies can support integration of heterogeneous data captured by different communities by relating them based on their semantic similarity. The W3C has proposed the Web Ontology Language (OWL) family of knowledge representation languages for authoring ontologies characterised by formal semantics on the Web[3][36].

ISO 19101-1 introduces the fundamental role of semantics in geographic information, and how the new technologies such as the Web, the Semantic Web, and many other emerging ways can support interoperability in the field of geographic information. It also provides an umbrella under which additional specific reference models on particular facets of geographic information standardization would be required. This document, introduced by ISO/TS 19150-1, particularly contributes to the description of geographic information service components and their behaviour for data processing purposes over the Web and to cast ISO geographic information standards to benefit from and support the Semantic Web by the way of ontologies as identified in ISO 19101-1.

Geographic information Web services are important components that compose the Web. The Semantic Web can contribute to facilitate the interaction between them by introducing an ontology for geographic information Web Services. It can support geographic information Web services to automate their discovery, composition, and invocation in order to enable seamless machine interoperation with minimum human interaction. Through ontologies, semantic annotation of geographic information services in terms of capabilities, selection, access, composition, and invocation are required to support interoperability of geographic information Web services on the Semantic Web[24]. Accordingly, this document sets a framework for geographic information service ontology and the description of geographic information Web services in OWL.

© ISO 2019 – All rights reserved

Geographic information — Ontology —

Part 4:
Service ontology

1 Scope

This document sets a framework for geographic information service ontology and the description of geographic information Web services in Web Ontology Language (OWL).

OWL is the language adopted for ontologies.

This document makes use of service metadata (ISO 19115-1) and service definitions (ISO 19119) whenever appropriate.

This document does not define semantics operators, rules for ontologies, and does not develop any application ontology.

In relation to ISO 19101-1:2014, 6.2, this document defines and formalizes the following purpose of the ISO geographic information reference model:

— geographic information service components and their behaviour for data processing purposes over the Web, and

— OWL ontologies to cast ISO/TC 211 standards to benefit from and support the Semantic Web.

In relation to ISO 19101-1:2014, 8.3, this document addresses the Meta:Service foundation of the ISO geographic information reference model.

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 19115-1, *Geographic information — Metadata — Part 1: Framework*

ISO 19119, *Geographic information — Service*

ISO 19150-2, *Geographic information — Ontology — Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)*

3 Terms, definitions, abbreviated terms, and namespaces

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/

© ISO 2019 – All rights reserved

3.1 Terms and definitions

3.1.1
aggregation
<UML> special form of *association* (3.1.2) that specifies a whole-part relationship between the aggregate (whole) and a component part

Note 1 to entry: See <UML> *composition* (3.1.8).

[SOURCE: ISO 19103:2015, 4.1]

3.1.2
association
<UML> semantic relationship that can occur between typed instances

Note 1 to entry: A binary association is an association among exactly two classifiers (including the possibility of an association from a classifier to itself).

[SOURCE: UML 2]

3.1.3
attribute
<UML> feature within a classifier that describes a range of values that instances of the classifier may hold

[SOURCE: UML 1]

3.1.4
cardinality
<UML> number of elements in a set

Note 1 to entry: Contrast with *multiplicity* (3.1.17), which is the range of possible cardinalities a set may hold.

[SOURCE: UML 1]

3.1.5
class
<OWL> set of individuals (3.1.14)

[SOURCE: OWL]

3.1.6
class
<UML> description of a set of objects that share the same *attributes* (3.1.3), operations, methods, relationships, and semantics

[SOURCE: UML 1]

3.1.7
codelist
value domain including a code for each permissible value

[SOURCE: ISO 19136:2007, 4.1.7]

3.1.8
composition
<UML> *aggregation* (3.1.1) where the composite object (whole) has responsibility for the existence and storage of the composed objects (parts)

[SOURCE: UML 2]

© ISO 2019 – All rights reserved

3.1.9
constraint
<UML> condition or restriction expressed in natural language text or in a machine readable language for the purpose of declaring some of the semantics of an element

[SOURCE: UML 2]

3.1.10
data property
<OWL> semantic *association* (3.1.2) between an *individual* (3.1.14) and a typed *literal* (3.1.15)

Note 1 to entry: Data properties were sometimes referred to as 'concrete properties' in Description Logic.

[SOURCE: OWL]

3.1.11
data type
specification of a value domain with operations allowed on values in this domain

EXAMPLE xsd:string, xsd:integer, xsd:decimal.

Note 1 to entry: Datatypes are distinct from classes of *individuals* (3.1.14), the latter are denoted by URIs and may be used by reference.

[SOURCE: ISO 19103:2015, 4.14, modified — EXAMPLE and Note 1 to entry have been replaced.]

3.1.12
domain
<ontology> restriction to constrain the subject class which participates in a subject-predicate-object triple

3.1.13
generalization
<UML> taxonomic relationship between a more general element and a more specific element of the same element type

Note 1 to entry: An instance of the more specific element can be used where the more general element is allowed.

[SOURCE: UML 2]

3.1.14
individual
instance of a class (3.1.5)

Note 1 to entry: "Individual" refers to a resource belonging to the extension of the class.

[SOURCE: OWL Web Ontology Language Guide — modified]

3.1.15
literal value
literal
constant, explicitly specified value

EXAMPLE "1"^^xsd:integer, "abc"^^xsd:string.

Note 1 to entry: This contrasts with a value that is determined by resolving a chain of substitution (e.g. a variable).

[SOURCE: ISO 19143:2010, 4.15]

© ISO 2019 – All rights reserved

3.1.16
metadata
information about a resource

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

3.1.17
multiplicity
<UML> specification of the range of allowable cardinalities that a set may assume

[SOURCE: ISO 19103:2015, 4.24]

3.1.18
object property
<OWL> semantic *association* (3.1.2) between a pair of *individuals* (3.1.14)

Note 1 to entry: Object properties have sometimes been referred to as 'abstract properties' in Description Logic.

[SOURCE: OWL]

3.1.19
ontology
formal representation of phenomena of a universe of discourse (3.1.23) with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships

[SOURCE: ISO 19101-1:2014, 4.1.26]

3.1.20
property
<RDF> relation between subject resources and object resources

[SOURCE: RDF]

3.1.21
property restriction
<OWL> special kind of *class* (3.1.5) description through the definition of constraints on values and cardinalities

[SOURCE: OWL]

3.1.22
range
<ontology> restriction to constrain the class of objects which participate in a subject-predicate-object triple

Note 1 to entry: A range restriction can be thought of as a type constraint on the value of a function or range of a relation.

3.1.23
universe of discourse
view of the real or hypothetical world that includes everything of interest

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

© ISO 2019 – All rights reserved

3.2 Abbreviated terms

OWL	Web Ontology Language (version 2)
RDF	Resource Description Framework
RDFS	RDF Schema
SKOS	Simplified Knowledge Organization System
UML	Unified Modeling Language
URI	Universal Resource Identifier

3.3 Namespaces

19150-4service	Requirements class for the identification and description of GeoWeb services http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceIdenficationAndDescription/
19150-4service-conf	Conformance class for the identification and description of GeoWeb Services http://standards.isotc211.org/iso19150/-4/1/conf/geowebServiceIdentificationAndDescription/
19150-4capabilities	Requirements class for the capabilities of GeoWeb services http://standards.isotc211.org/iso19150-4/req/geowebServiceIdenficationAndDescription/
19150-4capabilities-conf	Conformance class for the capabilities of GeoWeb Services http://standards.isotc211.org/iso19150/-4/1/conf/GeoWebServiceCapabilitiesgeowebServiceCapabilities/
19150-4metadata	Requirements class for the metadata of GeoWeb services http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceMetadata/
19150-4metadata-conf	Conformance class for the metadata of GeoWeb Services http://standards.isotc211.org/iso19150/-4/1/conf/geowebServiceMetadata/
19150-4owl	Requirements class for the OWL ontology http://standards.isotc211.org/iso19150/-4/1/req/owl/
19150-4owl-conf	Conformance class for the OWL ontology http://standards.isotc211.org/iso19150/-4/1/conf/owl/

4 Conformance

Any service description claiming conformance with this document shall pass the requirements described in the abstract test suite, presented in Annex A.

The abstract test suite is organized in four conformance classes (name and namespace) that address the following purposes:

— Geographic information Web service identification and description (19150-4service-conf);

— Geographic information Web service capabilities (19150-4capabilities-conf);

— Geographic information Web service metadata (19150-4metadata-conf); and

© ISO 2019 – All rights reserved