# INTERNATIONAL STANDARD

**ISO 19150-4**

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# Geographic information — Ontology —

## Part 4:
## Service ontology

*Information géographique — Ontologie —*

*Partie 4: Ontologie de service*

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# Foreword

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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*.

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.

# 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.

# 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/

## 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]

**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]

**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]

## 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

— Geographic information Web service ontology (19150-4owl-conf).

# 5 GeoWeb service ontology framework

## 5.1 General

Clause 5 sets the framework for the description of GeoWeb services. This framework is based on ISO 19119 for the description of geospatial services and ISO 19115-1 which defines the elements for the documentation of such services through service metadata. These two international standards set a foundation for the definition of GeoWeb service ontology framework. This framework is hereafter illustrated in UML. It also has been developed with consideration of the following documents:

— OWL-S: Semantic Markup for Web Services (OWL-S 1.1) (W3C Member Submission 22 November 2004);

— OWL-S: Semantic Markup for Web Services (OWL-S release 1.2);

— Semantic Web Services Ontology (SWSO) (W3C Member Submission 9 September 2005);

— Web Service Modeling Ontology (WSMO) (W3C Member Submission 3 June 2005);

— WSMO-Lite: Lightweight Semantic Descriptions for Services on the Web (W3C Member Submission 23 August 2010);

— OGC Web Service Common Implementation Specification, version 2.0.0, document #06-121r9.

This framework has been developed to support the use cases that are documented in Annex B.

The GeoWeb service framework consists of four elements that are GeoWeb service identification, GeoWeb service description, GeoWeb service capabilities, GeoWeb service metadata.

This document requires the use of standard HTTP URIs to identify resources in geographic information for the purpose of ontologies. The URI structures are defined in ISO 19150-2:2015, Annex B.

The requirements for representing GeoWeb Services in OWL ontologies comprise three requirements classes, identified as http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceIdenficationAndDescription/ (i.e. 19150-4service), http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceCapabilities/ (i.e. 19150-4capabilities) and http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceMetadata/ (i.e. 19150-4metadata).

## 5.2 GeoWeb service identification and description

### 5.2.1 General

The requirements for the identification and description of GeoWeb services are listed in Table 1 and illustrated in UML in Figure 1.

**Table 1 — Requirements class for GeoWeb service identification and description**

| Requirements class | |
|---|---|
| 19150-4service = http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceIdenficationAndDescription/ | |
| Target type | Ontology Framework |
| Dependency | http://standards.iso.org/iso/19103/ed-2/en/ (Conceptual schema language) |
| Dependency | http://standards.iso.org/iso/19119/ed-2/en/ (Service), clause 10 |
| Requirement | 19150-4service:GeoWebServiceIdentification |
| Requirement | 19150-4service:GeoWebServiceDescription |

**Table 1** *(continued)*

| Requirements class | |
|---|---|
| Requirement | 19150-4service:TaxonomyAndFunction |
| Requirement | 19150-4service:GeoWebServiceTaxonomy |
| Requirement | 19150-4service:GeoWebServiceFunction |
| Requirement | 19150-4service:GeoWebServiceLifeCycle |
| Requirement | 19150-4service:ServiceParameters |
| Requirement | 19150-4service:ServiceCost |

**GeoWebServiceIdentification**

+ identifier: URI
+ name: CharacterString
+ taxonomyAndFunction: TaxonomyFunctionPair [1..*]
+ lifeCycle: GeoWebServiceLifeCycle [1..*]

+description  1

**GeoWebServiceDescription**

+ description: CharacterString
+ subject: GenericName
+ version: CharacterString
+ date: CI_Date [0..*]
+ language: LanguageCode [1..*]
+ source: URI [0..*]
+ contact: CI_Responsibility [0..*]
+ rights: CharacterString [0..*]
+ cost: ServiceCost [0..1]
+ url: URI [0..*]

+parameters    0..1

**ServiceParameters**

+ parameter: CharacterString [0..*]
+ input: CharacterString [0..*]
+ output: CharacterString [0..*]
+ precondition: CharacterString [0..*]
+ result: CharacterString [1..*]

+serviceChainingInformation    0..*

**SV_OperationChainMetadata**

+ name: CharacterString
+ description: CharacterString [0..1]

**TaxonomyFunctionPair**

+ taxonomy: GeoWebServiceTaxonomy
+ function: GeoWebServiceFunction [0..*]

*constraints*
{self.taxonomy = "geographicBoundaryHumanInteraction" implies self.function.oclAsType(GeoWebBoundaryHumanInteractionServiceFunction)}
{self.taxonomy = "geographicModelInformationManagement" implies self.function.oclAsType(GeoWebcWorkflowTaskFunction)}
{self.taxonomy = "geographicWorkflowTaskManagement" implies self.function.oclAsType(GeoWebWorkflowTaskManagementFunction)}
{self.taxonomy = "geographicProcessing" implies self.function.oclAsType(GeoWebProcessingFunction)}
{self.taxonomy = "geographicProcessingSpatial" implies self.function.oclAsType(GeoWebProcessingSpatialFunction)}
{self.taxonomy = "geographicProcessingThematic" implies self.function.oclAsType(GeoWebProcessingThematicFunction)}
{self.taxonomy = "geographicProcessingTemporal" implies self.function.oclAsType(GeoWebProcessingTemporalFunction)}
{self.taxonomy = "geographicProcessingMetadata" implies self.function.oclAsType(GeoWebProcessingMetadataFunction)}
{self.taxonomy = "communication" implies self.function.oclAsType(GeoWebCommunicationFunction)}
{self.taxonomy = SystemManagementSecurity" implies self.function.oclAsType(GeoWebSystemManagementSecurityFunction)}

«CodeList»
**GeoWebServiceLifeCycle**

+ register
+ discovery
+ view
+ download
+ invoke
+ orchestrationAndComposition
+ securityAndRightsManagement

«CodeList»
**GeoWebServiceTaxonomy**

+ geographicBoundaryHumanInteraction
+ geographicModelInformationManagement
+ geographicWorkflowTaskManagement
+ geographicProcessing
+ geographicProcessingSpatial
+ geographicProcessingThematic
+ geographicProcessingTemporal
+ geographicProcessingMetadata
+ communication
+ systemManagementSecurity

«CodeList»
**GeoWebServiceFunction**

«union»
**ServiceCost**

+ monetaryUnitCost: Currency
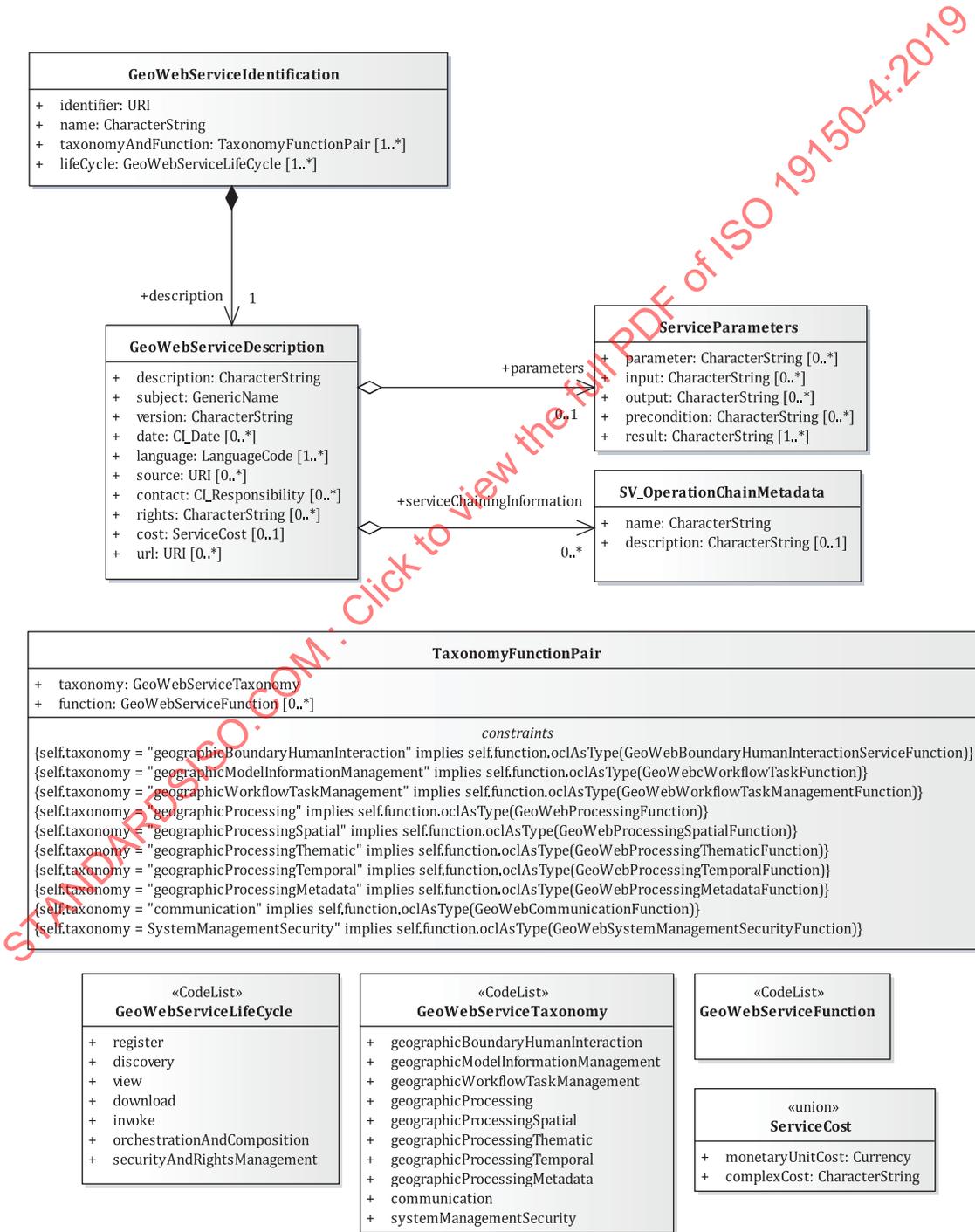+ complexCost: CharacterString

**Figure 1 — UML diagram for GeoWeb service identification and description**

### 5.2.2 GeoWeb service identification

#### 5.2.2.1 Semantics

A GeoWeb service is a computational entity which is able (by invocation) to achieve a user's goal related to geographic information. The class GeoWebServiceIdentification provides basic information about the GeoWeb service.

#### 5.2.2.2 Requirements

Table 2 lists the requirements for the identification of GeoWeb services.

**Table 2 — GeoWeb service identification requirements**

| Requirement |
| --- |
| 19150-4service:GeoWebServiceIdentification |
| A GeoWeb service shall be described by a class and identified with the following properties which are further described in 5.2.2.3:<br>— identifier;<br><br>— name;<br><br>— taxonomyAndFunction;<br><br>— lifeCycle; and<br><br>— description. |

#### 5.2.2.3 Properties

Table 3 sets the properties for the identification of GeoWeb services.

**Table 3 — GeoWeb service identification properties**

| Name | Semantics | Multiplicity | Range |
| --- | --- | --- | --- |
| identifier | Unambiguous reference to the GeoWeb service. | 1..1 | URI |
| name | Name identifying the GeoWeb service that is being offered. | 1..1 | CharacterString |
| taxonomyAndFunction | A pair of taxonomy and function(s) values. | 1..* | TaxonomyFunctionPair |
| lifeCycle | Usage oriented life cycle perspective description. | 1..* | GeoWebServiceLifeCycle |
| description (role) | Account of the content of the GeoWeb service. | 1..1 | GeoWebServiceDescription |

### 5.2.3 GeoWeb service description

#### 5.2.3.1 Semantics

The class GeoWebServiceDescription provides detailed information about the GeoWeb Service.

#### 5.2.3.2 Requirements

Table 4 lists the requirements for the description of GeoWeb services.

**Table 4 — GeoWeb service description requirements**

| Requirement |
| --- |
| 19150-4service:GeoWebServiceDescription |
| A GeoWeb service shall be described with the following properties which are further described in 5.2.3.3: <br> — description; <br> — subject; <br> — version; <br> — date; <br> — language; <br> — source; <br> — contact; <br> — rights; <br> — cost; <br> — url; <br> — parameters; and <br> — ServiceChainingInformation. |

### 5.2.3.3 Properties

Table 5 sets the properties for the description of GeoWeb services.

**Table 5 — GeoWeb service description properties**

| Name | Semantics | Multiplicity | Range |
| --- | --- | --- | --- |
| description | Brief account of the content of the GeoWeb service which may include a summary of what the service offers and any requirements that the service has. | 1..1 | CharacterString |
| subject | Topic of the GeoWeb service. | 1..1 | GenericName |
| version | Identifier for the specific release of the GeoWeb service at a precise time. | 1..1 | CharacterString |
| date | Date of an event in the life cycle of the GeoWeb service. | 0..* | CI_Date |
| language | ISO 639-1 2 letter code or ISO 639-2 3 letter code identifier of the language of the GeoWeb service. | 1..* | LanguageCode |
| source | Reference to an element from which the present GeoWeb service is derived. | 0..* | URI |
| contact | Reference to humans or individuals responsible for the GeoWeb service or to some aspects of the service. | 0..* | CI_Responsibility |
| rights | Information about rights held in and over the GeoWeb service. | 0..* | CharacterString |

**Table 5** *(continued)*

| Name | Semantics | Multiplicity | Range |
|---|---|---|---|
| cost | Cost information requested for accessing the GeoWeb service.<br><br>NOTE   The service may be free. | 0..1 | ServiceCost |
| url | URL associated with the GeoWeb service. | 0..* | URI |
| parameters (role) | Parameters required to invoke the GeoWeb service. | 0..1 | ServiceParameters |
| serviceChainingInformation (role) | Description of the GeoWeb service chaining. | 0..* | SV_OperationChainMetadata |

### 5.2.4   Taxonomy and function

#### 5.2.4.1   Semantics

TaxonomyFunctionPair provides synchronized function values to the taxonomy value.

#### 5.2.4.2   Requirements

Table 6 lists the requirements for the taxonomy and function pair.

**Table 6 — Taxonomy and function pair requirements**

| Requirement |
|---|
| 19150-4service:TaxonomyFunctionPair |
| A taxonomy and function pair shall be described with the following properties which are further described in 5.2.4.3:<br><br>— taxonomy; and<br><br>— function.<br><br>The function property value shall be synchronized with the taxonomy property value:<br><br>— use the codelist GeoWebBoundaryHumanInteractionServiceFunction when taxonomy is set to "geographicBoundaryHumanInteraction";<br><br>— use the codelist GeoWebcWorkflowTaskFunction when taxonomy is set to "geographicModelInformationManagement";<br><br>— use the codelist GeoWebWorkflowTaskManagementFunction when taxonomy is set to "geographicWorkflowTaskManagement";<br><br>— use the codelist GeoWebProcessingFunction when taxonomy is set to "geographicProcessing";<br><br>— use the codelist GeoWebProcessingSpatialFunction when taxonomy is set to "geographicProcessingSpatial";<br><br>— use the codelist GeoWebProcessingThematicFunction when taxonomy is set to "geographicProcessingThematic";<br><br>— use the codelist GeoWebProcessingTemporalFunction when taxonomy is set to "geographicProcessingTemporal";<br><br>— use the codelist GeoWebProcessingMetadataFunction when taxonomy is set to "geographicProcessingMetadata";<br><br>— use the codelist GeoWebCommunicationFunction when taxonomy is set to "communication";<br><br>— use the codelist GeoWebSystemManagementSecurityFunction when taxonomy is set to "SystemManagementSecurity. |

### 5.2.4.3 Properties

Table 7 sets the properties for taxonomy and function of GeoWeb services.

**Table 7 — GeoWeb service taxonomy and function properties**

| Name | Semantics | Multiplicity | Range |
|---|---|---|---|
| taxonomy | Nature of the GeoWeb service. | 1..1 | GeoWebServiceTaxonomy |
| function | Purpose of the GeoWeb service. | 0..* | GeoWebServiceFunction |

## 5.2.5 GeoWeb service taxonomy

### 5.2.5.1 Semantics

GeoWebServiceTaxonomy is a codelist providing taxonomy code values.

### 5.2.5.2 Requirements

Table 8 lists the requirements for GeoWeb service taxonomy.

**Table 8 — GeoWeb service taxonomy requirements**

| Requirement |
|---|
| 19150-4service:GeoWebServiceTaxonomy |
| The code values for GeoWebServiceTaxonomy shall include the following values which are further described in 5.2.5.3:<br>— geographicBoundaryHumanInteraction;<br>— geographicModelInformationManagement;<br>— geographicWorkflowTaskManagement;<br>— geographicProcessing;<br>— geographicProcessingSpatial;<br>— geographicProcessingThematic;<br>— geographicProcessingTemporal;<br>— geographicProcessingMetadata;<br>— communication; and<br>— systemManagementSecurity. |

### 5.2.5.3 Code values

Table 9 sets the code values for GeoWeb service taxonomy.

**Table 9 — GeoWeb service taxonomy code values**

| Code value | Semantics |
|---|---|
| geographicBoundaryHumanInteraction | GeoWeb services for management of user interfaces, graphics, multimedia and for presentation of compound document, user interface dialogues and interaction with other system boundary elements like physical sensors. |
| geographicModelInformationManagement | GeoWeb services for management of the development, manipulation and storage of metadata, conceptual schemas and datasets. |
| geographicWorkflowTaskManagement | GeoWeb services for support of specific tasks or work-related activities conducted by humans. These services support use of resources and development of products involving a sequence of activities or steps that may be conducted by different persons. |
| geographicProcessing | GeoWeb services that perform large-scale computations involving substantial amounts of data. Examples include services for providing the time of day, spelling checkers and services that perform coordinate transformations (e.g. that accept a set of coordinates expressed using one reference system and converting them to a set of coordinates in a different reference system). A processing service does not include capabilities for providing persistent storage of data or transfer of data over networks. |
| geographicProcessingSpatial | GeoWeb services that perform large-scale computations involving substantial amounts of spatial data. |
| geographicProcessingThematic | GeoWeb services that perform large-scale computations involving substantial amounts of thematic data. |
| geographicProcessingTemporal | GeoWeb services that perform large-scale computations involving substantial amounts of temporal data. |

**Table 9** *(continued)*

| Code value | Semantics |
|---|---|
| geographicProcessingMetadata | GeoWeb services that perform large-scale computations involving substantial amounts of metadata. |
| communication | GeoWeb services for encoding and transfer of data across communications networks. |
| systemManagementSecurity | GeoWeb services for the management of system components, applications and networks. These services also include management of user accounts and user access privileges. |

### 5.2.6   GeoWeb service function

#### 5.2.6.1   Semantics

GeoWebServiceFunction is the root of a hierarchy of codelists providing function code values aligned with the different taxonomy values.
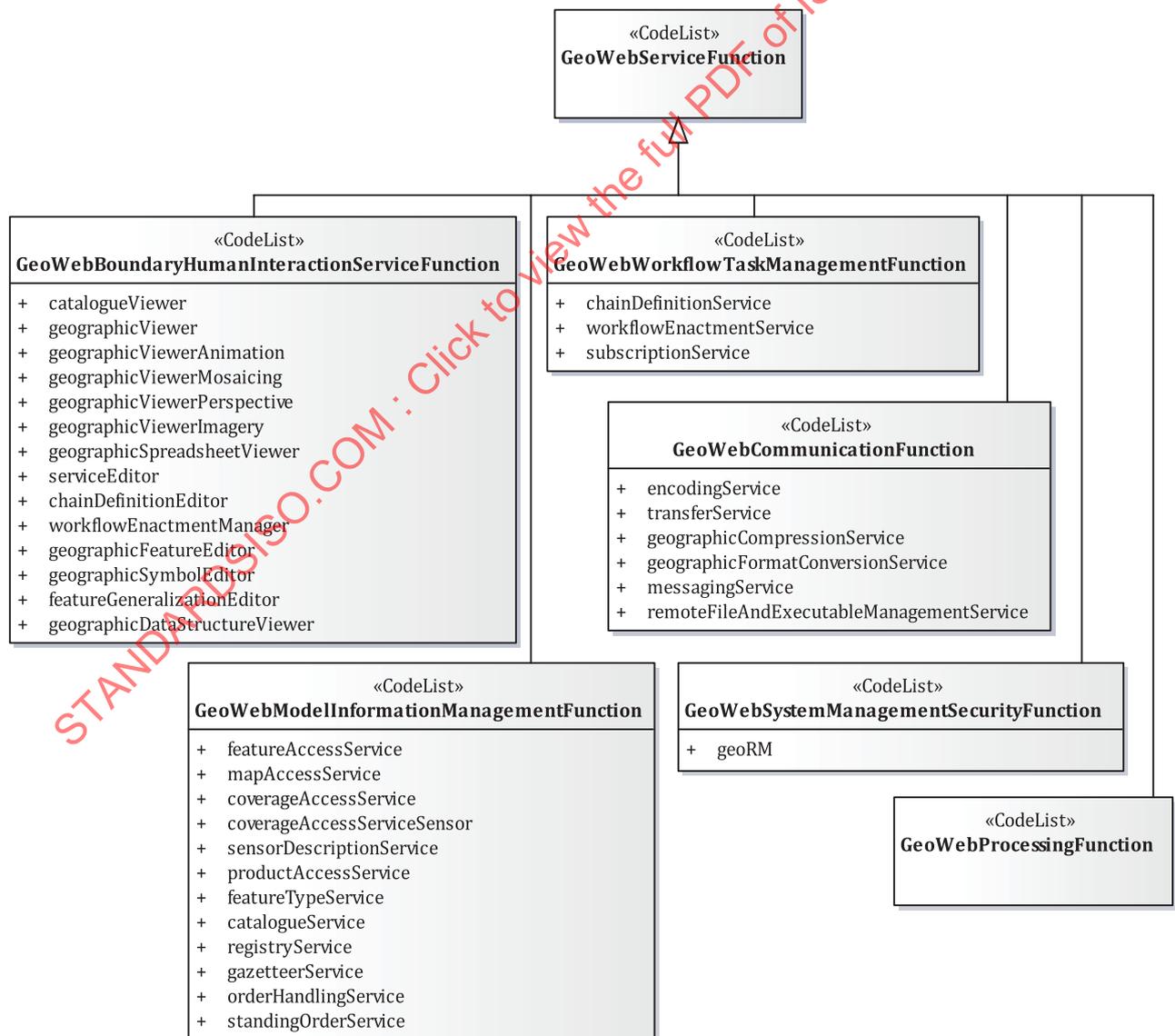
It is illustrated in UML in Figures 2 and 3.



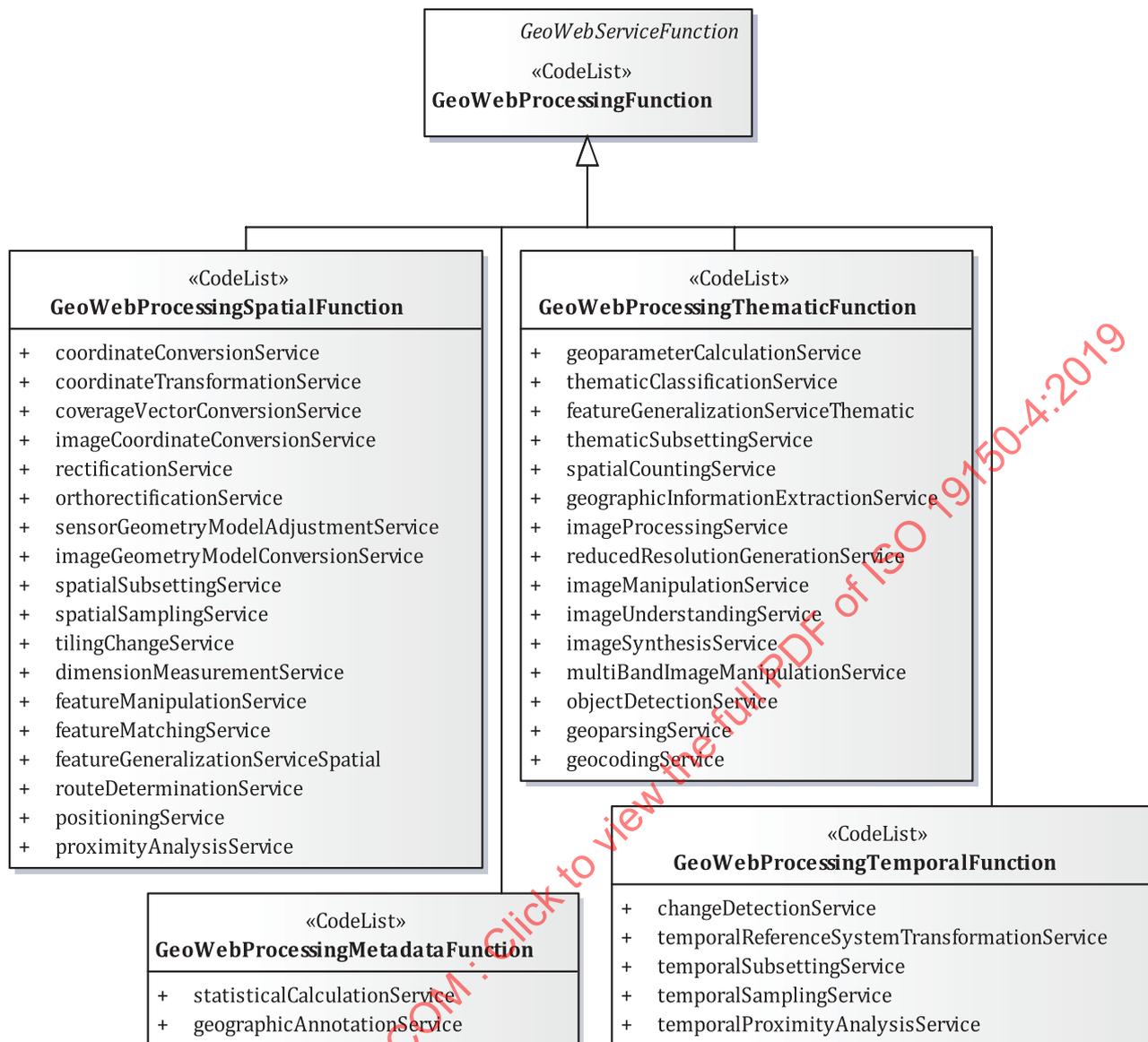**Figure 2 — UML diagram for GeoWeb service functions**

**Figure 3 — UML diagram for GeoWeb service processing functions**

### 5.2.6.2 Requirements

Table 10 lists the requirements for GeoWeb service functions.

**Table 10 — GeoWeb service function requirements**

| Requirement |
| --- |
| 19150-4service:GeoWebServiceFunction |
| The GeoWebServiceFunction shall be set as the root of the following sub-codelists:<br><br>— GeoWebBoundaryHumanInteractionServiceFunction;<br><br>— GeoWebModelInformationManagementFunction;<br><br>— GeoWebWorkflowTaskManagementFunction;<br><br>— GeoWebProcessingFunction;<br><br>— GeoWebCommunicationFunction; and<br><br>— GeoWebSystemManagementSecurityFunction.<br><br>The GeoWebProcessingFunction shall be set as the root of the following sub-codelists:<br><br>— GeoWebProcessingSpatialFunction;<br><br>— GeoWebProcessingThematicFunction;<br><br>— GeoWebProcessingTemporalFunction; and<br><br>— GeoWebProcessingMetadataFunction.<br><br>The code values for GeoWebBoundaryHumanInteractionServiceFunction shall include the following values which are further described in 5.2.6.3:<br><br>— catalogueViewer;<br><br>— geographicViewer;<br><br>— geographicViewerAnimation;<br><br>— geographicViewerMosaicing;<br><br>— geographicViewerPerspective;<br><br>— geographicViewerImagery;<br><br>— geographicSpreadsheetViewer;<br><br>— serviceEditor;<br><br>— chainDefinitionEditor;<br><br>— workflowEnactmentManager;<br><br>— geographicFeatureEditor;<br><br>— geographicSymbolEditor;<br><br>— featureGeneralizationEditor; and<br><br>— geographicDataStructureViewer. |

**Table 10** *(continued)*

| Requirement |
|---|
| The code values for GeoWebModelInformationManagementFunction shall include the following values which are further described in <u>5.2.6.3</u>:<br><br>— featureAccessService;<br><br>— mapAccessService;<br><br>— coverageAccessService;<br><br>— coverageAccessServiceSensor;<br><br>— sensorDescriptionService;<br><br>— productAccessService;<br><br>— featureTypeService;<br><br>— catalogueService;<br><br>— registryService;<br><br>— gazetteerService;<br><br>— orderHandlingService; and<br><br>— standingOrderService.<br><br>The code values for GeoWebWorkflowTaskManagementFunction shall include the following values which are further described in <u>5.2.6.3</u>:<br><br>— chainDefinitionService;<br><br>— workflowEnactmentService; and<br><br>— subscriptionService.<br><br>The code values for GeoWebProcessingSpatialFunction shall include the following values which are further described in <u>5.2.6.3</u>:<br><br>— coordinateConversionService;<br><br>— coordinateTransformationService;<br><br>— coverageVectorConversionService;<br><br>— imageCoordinateConversionService;<br><br>— rectificationService;<br><br>— orthorectificationService;<br><br>— sensorGeometryModelAdjustmentService;<br><br>— imageGeometryModelConversionService;<br><br>— spatialSubsettingService;<br><br>— spatialSamplingService;<br><br>— tilingChangeService;<br><br>— dimensionMeasurementService;<br><br>— featureManipulationService; |

**Table 10** *(continued)*

| Requirement |
| --- |
| — featureMatchingService; |
| — featureGeneralizationServiceSpatial; |
| — routeDeterminationService; |
| — positioningService; and |
| — proximityAnalysisService. |
| The code values for GeoWebProcessingThematicFunction shall include the following values which are further described in 5.2.6.3: |
| — geoparameterCalculationService; |
| — thematicClassificationService; |
| — featureGeneralizationServiceThematic; |
| — thematicSubsettingService; |
| — spatialCountingService; |
| — geographicInformationExtractionService; |
| — imageProcessingService; |
| — reducedResolutionGenerationService; |
| — imageManipulationService; |
| — imageUnderstandingService; |
| — imageSynthesisService; |
| — multiBandImageManipulationService; |
| — objectDetectionService; |
| — geoparsingService; and |
| — geocodingService. |
| The code values for GeoWebProcessingTemporalFunction shall include the following values which are further described in 5.2.6.3: |
| — changeDetectionService; |
| — temporalReferenceSystemTransformationService; |
| — temporalSubsettingService; |
| — temporalSamplingService; and |
| — temporalProximityAnalysisService. |
| The code values for GeoWebProcessingMetadataFunction shall include the following values which are further described in 5.2.6.3: |
| — statisticalCalculationService; and |
| — geographicAnnotationService. |

**Table 10** *(continued)*

| Requirement |
| --- |
| The code values for GeoWebCommunicationFunction shall include the following values which are further described in 5.2.6.3:<br><br>— encodingService;<br><br>— transferService;<br><br>— geographicCompressionService;<br><br>— geographicFormatConversionService;<br><br>— messagingService; and<br><br>— remoteFileAndExecutableManagementService.<br><br>The code values for GeoWebSystemManagementSecurityFunction shall include the following values which are further described in 5.2.6.3:<br><br>— geoRM. |

### 5.2.6.3   Code values

Table 11 sets the code values for the codelist GeoWebBoundaryHumanInteractionServiceFunction.

**Table 11 — GeoWebBoundaryHumanInteractionServiceFunction code values**

| Code value | Semantics |
| --- | --- |
| catalogueViewer | Client GeoWeb service that allows a user to interact with a catalogue to locate, browse, and manage metadata about geographic data or geographic services. |
| geographicViewer | Client GeoWeb service that allows a user to view one or more feature collections or coverages. This viewer allows a user to interact with map data, e.g. displaying, overlaying and querying.<br><br>NOTE   ISO 19128 and OGC Web Map Service compliant services are part of this kind of viewer. |
| geographicViewerAnimation | Geographic viewer that allows a human to sequence views of the same geographic location at different times. |
| geographicViewerMosaicing | Geographic viewer that allows combination of views of geographic data for adjacent areas into a single view. |
| geographicViewerPerspective | Geographic viewer that allows the viewpoint to be changed; for example, to specify how high off the ground, what direction, and from what angle a viewpoint is seeing a scene. |
| geographicViewerImagery | Geographic viewer that visualizes coverage data including the mapping of sample dimensions in the coverage to colours in the display. |
| geographicSpreadsheetViewer | Client GeoWeb service that allows a user to interact with multiple data objects and to request calculations similar to an arithmetic spreadsheet, but extended to geographic data. |
| serviceEditor | Client GeoWeb service that allows a user to control geographic processing services. Views include understanding a service, composing/scripting service chains, invoking a service, status of a service, scheduling services for peak performance times, and invoking a service chain. |
| chainDefinitionEditor | Client GeoWeb service that provides user interaction with a chain definition service. |
| workflowEnactmentManager | Client GeoWeb service that provides user interaction with a workflow enactment service. |

**Table 11** *(continued)*

| Code value | Semantics |
|---|---|
| geographicFeatureEditor | Geographic viewer that allows a user to interact with feature data, e.g. displaying, querying; supports feature annotation. The user controls view orientation, perspective, depth cueing, hidden-line/surface, light-sources, transparency, and texture mapping onto the objects. Objects in view can be picked or drawn on to generate new objects in the model. |
| geographicSymbolEditor | Client GeoWeb service that allows a human to select and manage symbol libraries.<br><br>NOTE   ISO 19117 is relevant to symbol libraries. |
| featureGeneralizationEditor | Client GeoWeb service that allows a user to modify the cartographic characteristics of a feature or feature collection by simplifying its visualization, while maintaining its salient elements — the spatial equivalent of simplification. |
| geographicDataStructureViewer | Client GeoWeb service that allows a user to access part of a dataset to see its internal structure, to request creation of new objects from parts of an object being browsed and to request a check of an object, e.g. type checking. |

Table 12 sets the code values for the codelist GeoWebModelInformationManagementFunction.

**Table 12 — GeoWebModelInformationManagementFunction code values**

| Code value | Semantics |
|---|---|
| featureAccessService | GeoWeb service that provides a client access to and management of a feature store. An access service may include a query that filters the data returned to the client.<br><br>NOTE   ISO 19125, ISO 19142 and ISO 19143 are relevant to feature access. |
| mapAccessService | GeoWeb service that provides a client access to a geographic graphics, i.e. pictures of geographic data.<br><br>NOTE   ISO 19128 is relevant to map access. |
| coverageAccessService | GeoWeb service that provides a client access to and management of a coverage store. Coverage is considered as a special case of Feature. An access service may include a query that filters the data returned to the client.<br><br>NOTE   ISO 19123 and ISO 19111 are relevant to coverage access. |
| coverageAccessServiceSensor | GeoWeb service that provides access to coverage where the source of the coverage data is a real-time sensor, i.e. not a persistent store. |
| sensorDescriptionService | GeoWeb service that provides the description of a coverage sensor, including sensor location and orientation, as well as the sensor's geometric, dynamic and radiometric characteristics for geoprocessing purposes. |
| productAccessService | GeoWeb service that provides access to and management of a geographic product store. A product can be a predefined feature collection and metadata with known boundaries and content, corresponding to a paper map or report. A product can alternately be a previously defined set of coverages with associated metadata. |
| featureTypeService | GeoWeb service that provides a client access to and management of a store of feature type definitions.<br><br>NOTE   The static and dynamic information models for a feature type catalogue are provided in ISO 19110. |

**Table 12** *(continued)*

| Code value | Semantics |
|---|---|
| catalogueService | GeoWeb service that provides discovery and management services on a store of metadata about instances. The metadata may be for dataset instances, e.g. dataset catalogue, or may contain service metadata, e.g. service catalogue.<br><br>NOTE   ISO 19115-1 is relevant to catalogue service for dataset metadata. ISO 19115-2 is relevant for service metadata. |
| registryService | GeoWeb service that provides access to a store of metadata about types. Types are vocabularies that can be organized and related to each other.<br><br>EXAMPLE   information community registries, type dictionaries, service registries and schema registries. |
| gazetteerService | GeoWeb service that provides access to a directory of instances of a class or classes of real-world phenomena containing some information regarding position.<br><br>NOTE   An information model for a gazetteer is provided by ISO 19112. |
| orderHandlingService | GeoWeb service that provides a client with the ability to order products from a provider, including the formulation of quotes on orders, selection of geographic processing options, submission of an order, statusing of orders and billing and accounting of users' orders. |
| standingOrderService | GeoWeb order-handling service that allows a user to request that a product over a geographic area be disseminated when it becomes available. Such dissemination includes receiving, preparing (i.e. reformatting, compressing, decompressing, etc.), prioritizing, and transmitting the geographic information requested through standing queries or profiles. |

Table 13 sets the code values for the codelist GeoWebWorkflowTaskManagementFunction.

**Table 13 — GeoWebWorkflowTaskManagementFunction code values**

| Code value | Semantics |
|---|---|
| chainDefinitionService | GeoWeb service to define a chain and to enable it to be executed by the workflow enactment service. This includes information about its starting and completion conditions, constituent activities and rules for navigating between them, user tasks to be undertaken, references to applications which may be invoked, definition of any workflow relevant data which may need to be referenced, etc. Chain definition service may also provide a chain validation service. |
| workflowEnactmentService | GeoWeb service that interprets a chain and controls the instantiation of services and sequencing of activities. This is done through one or more co-operating workflow management engines, which manage the execution of individual instances of the various services. A workflow enactment service maintains control data either centralized or distributed across a set of workflow engines. Workflow control data include the internal state information associated with the various services under execution and may also include check-pointing and recovery/restart information used by the workflow engines to coordinate and recover from failure conditions. |
| subscriptionService | GeoWeb service to allow clients to register for notification about events. Events are defined by a service that performs an activity resulting in the event. Events are catalogued by the subscription service. Clients identify events of interest, e.g. receipt of data with a specific geographic extent. When an event occurs, the subscription service sends notification to all clients who have registered an interest in the event. Once an event occurs, a subscription service may cause an activity to occur, e.g. delivery of a product. |

Table 14 sets the code values for the codelist GeoWebProcessingSpatialFunction.

**Table 14 — GeoWebProcessingSpatialFunction code values**

| Code value | Semantics |
|---|---|
| coordinateConversionService | GeoWeb service to change coordinates from one coordinate system to another coordinate system that is related to the same datum. In a coordinate conversion, the parameters' values are exact. Coordinate conversion services include map projection services.<br>NOTE   ISO 19111 is relevant to coordinate conversion. |
| coordinateTransformationService | GeoWeb service to change coordinates from a coordinate reference system based on one datum to a coordinate reference system based on a second datum. A coordinate transformation differs from a coordinate conversion in that the coordinate transformation parameter values are derived empirically; therefore, there may be several different estimations (or realizations).<br>NOTE   ISO 19111 is relevant to coordinate transformation. |
| coverageVectorConversionService | GeoWeb service to change the spatial representation from a coverage schema to a vector schema or vice versa.<br>NOTE   A standard relevant to vector schema definition is ISO 19107. A standard relevant to coverage schema definition is ISO 19123. |

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**Table 14** *(continued)*

| Code value | Semantics |
|---|---|
| imageCoordinateConversionService | Coordinate transformation or coordinate conversion service to change the coordinate reference system for an image.<br><br>NOTE    A standard relevant to image coordinates is ISO 19123; standardization relevant to image coordinates is also discussed in ISO/TR 19121. |
| rectificationService | GeoWeb service that projects a tilted or oblique image onto a selected plane or other surface. The plane is often horizontal, but can be tilted to achieve some desired condition, such as to better fit the local surface of the Earth. |
| orthorectificationService | Rectification service that removes image displacement due to variation in terrain elevation. Orthorectification requires use of digital elevation data, usually in grid form. |
| sensorGeometryModelAdjustmentService | GeoWeb service that adjusts sensor geometry models to improve the match of the image with other images and/or known ground positions. |
| imageGeometryModelConversionService | GeoWeb service that converts sensor geometry models into a different but equivalent sensor geometry model. |
| spatialSubsettingService | GeoWeb service that extracts data from an input in a continuous spatial region either by geographic location or by grid coordinates. |
| spatialSamplingService | GeoWeb service that extracts data from an input using a consistent sampling scheme either by geographic location or by grid coordinates. |
| tilingChangeService | GeoWeb service that changes the tiling of geographic data. |
| dimensionMeasurementService | GeoWeb service to compute dimensions of objects visible in an image or other geodata. An alternative name for this service is image mensuration service. |
| featureManipulationService | GeoWeb service to register one feature to another, an image, or another dataset or coordinate set; correcting for relative translation shifts, rotational differences, scale differences, and perspective differences; verifying that all features in the Feature Collection are topologically consistent according to the topology rules of the Feature Collection, and identifying and/or correcting any inconsistencies that are discovered. |
| featureMatchingService | GeoWeb service that determines which features and portions of features represent the same real-world entity from multiple data sources, e.g. edge matching and limited conflation. |
| featureGeneralizationServiceSpatial | GeoWeb service that reduces spatial variation in a feature collection to increase the effectiveness of communication by counteracting the undesirable effects of scale reduction. |
| routeDeterminationService | GeoWeb service to determine the optimal path between two specified points based on the input parameters and properties contained in the Feature Collection; may also determine the measured distance between two points along a specified path based on the properties supported in the Feature Collection further, may determine the length of time it takes to follow a route through the geographic data in the Feature Collection. |
| positioningService | GeoWeb service provided by a position-providing device to use, obtain and unambiguously interpret position information and determines whether the results meet the requirements of the use.<br><br>NOTE    A standard relevant to position services is ISO 19116. |
| proximityAnalysisService | GeoWeb service that, given a position or geographic feature, finds all objects with a given set of attributes that are located within a user-specified distance of the position or feature. |

Table 15 sets the code values for the codelist GeoWebProcessingThematicFunction.

**Table 15 — GeoWebProcessingThematicFunction code values**

| Code value | Semantics |
|---|---|
| geoparameterCalculationService | GeoWeb service to derive application-oriented quantitative results that are not available from the raw data themselves. |
| thematicClassificationService | GeoWeb service to classify regions of geographic data based on thematic attributes. Classification of coverages (including images) subdivides a coverage into regions based on attribute values. Classification of features sorts features into groups based on attribute values or feature associations. |
| featureGeneralizationServiceThematic | GeoWeb service that generalizes feature types in a feature collection to increase the effectiveness of communication by counteracting the undesirable effects of data reduction. |
| thematicSubsettingService | GeoWeb service that extracts features or coverage elements from a larger set based on thematic characteristics. |
| spatialCountingService | GeoWeb service that counts geographic features of a given type within a specified area. |
| geographicInformationExtractionService | GeoWeb service supporting the extraction of feature and terrain information from remotely sensed and scanned images. |
| imageProcessingService | GeoWeb service to change the values of thematic attributes of an image using a mathematical function. <br><br> EXAMPLE   convolution, data compression, feature extraction, frequency filters, geometric operations, nonlinear filters and spatial filters. |
| reducedResolutionGenerationService | GeoWeb service that reduces the resolution of an image. |
| imageManipulationService | GeoWeb service for manipulating data values in images; changing colour and contrast values, applying various filters, manipulating image resolution, noise removal, "striping", systematic-radiometric corrections, atmospheric attenuation, changes in scene illumination, etc. |
| imageUnderstandingService | GeoWeb service that provides automated image change detection, registered image differencing, significance-of-difference analysis and display and area-based and model-based differencing. |
| imageSynthesisService | GeoWeb service for creating or transforming images using computer-based spatial models, perspective transformations, and manipulations of image characteristics to improve visibility, sharpen resolution, and/or reduce the effects of cloud cover or haze. |
| multiBandImageManipulationService | GeoWeb service that modifies an image using the multiple bands of the image. <br><br> EXAMPLE   ratioing, principal components transformation, intensity-hue-saturation colour space transformation, and de-correlation-stretching. |
| objectDetectionService | GeoWeb service to detect real-world objects in an image. |
| geoparsingService | GeoWeb service to scan text documents for location-based references, such as a place names, addresses, postal codes, etc., in preparation for passage to a geocoding service. |
| geocodingService | GeoWeb service to augment location-based text references with geographic coordinates (or some other spatial reference). |

Table 16 sets the code values for the codelist GeoWebProcessingTemporalFunction.

**Table 16 — GeoWebProcessingTemporalFunction code values**

| Code value | Semantics |
|---|---|
| changeDetectionService | GeoWeb service to find differences between two datasets that represent the same geographical area at different times. |
| temporalReferenceSystemTransformationService | GeoWeb service to change the values of temporal instances from one temporal reference system to another temporal reference system. NOTE  ISO 19108 is relevant to temporal reference systems. Using the terminology of ISO 19108, a temporal reference system transformation service replaces the TM_Position value of a given TM_Instant with an equivalent TM_Position value associated with a different temporal reference system. |
| temporalSubsettingService | GeoWeb service that extracts data from an input in a continuous interval based on temporal position values. |
| temporalSamplingService | GeoWeb service that extracts data from an input using a consistent sampling scheme based on temporal position values. |
| temporalProximityAnalysisService | GeoWeb service that, given a temporal interval or event, find all objects with a given set of attributes that are located within a user-specified interval from the interval or event. |

Table 17 sets the code values for the codelist GeoWebProcessingMetadataFunction.

**Table 17 — GeoWebProcessingMetadataFunction code values**

| Code value | Semantics |
|---|---|
| statisticalCalculationService | GeoWeb service to calculate the statistics of a dataset, e.g. mean, median, mode and standard deviation; histogram statistics and histogram calculation; minimum and maximum of an image; multi-band cross-correlation matrix; spectral statistics; spatial statistics; and other statistical calculations. |
| geographicAnnotationService | GeoWeb service to add ancillary information to an image or a feature in a Feature Collection (e.g. by way of a label, a hot link, or an entry of a property for a feature into a database) that augments or provides a more complete description. |

Table 18 sets the code values for the codelist GeoWebCommunicationFunction.

**Table 18 — GeoWebCommunicationFunction code values**

| Code value | Semantics |
|---|---|
| encodingService | GeoWeb service that provides implementation of an encoding rule and provides an interface to encoding and decoding functionality. |
| | NOTE   ISO 19118 is a standard relevant to encoding. |
| transferService | GeoWeb service that provides implementation of one or more transfer protocols, which allows data transfer between distributed information systems over off-line or online communication media. To successfully transfer data between two systems, the sender and receiver need to agree on the transfer protocol to be used. |
| | NOTE   ISO 19118 is a standard relevant to transfer. For some geographic datasets, large data-object transfer is required. |
| geographicCompressionService | GeoWeb service that converts spatial portions of a feature collection to and from compressed form. |
| geographicFormatConversionService | GeoWeb service that converts from one geographic data format to another. |
| messagingService | GeoWeb service that allows multiple users to simultaneously view, comment about, and request edits of feature collections. This service allows collaboration involving geographic data. |
| remoteFileAndExecutableManagementService | GeoWeb service that provides access to secondary storage of geographic features as if it were local to the client. |

Table 19 sets the code values for the codelist GeoWebSystemManagementSecurityFunction.

**Table 19 — GeoWebSystemManagementSecurityFunction code values**

| Code value | Semantics |
|---|---|
| geoRM | Geospatial Right Management (ISO 19153). |

### 5.2.7   GeoWeb service lifecycle

#### 5.2.7.1   Semantics

GeoWebServiceLifeCycle is a codelist providing usage-oriented life cycle perspective code values.

#### 5.2.7.2   Requirements

Table 20 lists the requirements for GeoWeb service lifecycle.

**Table 20 — GeoWeb service lifecycle requirements**

| Requirement |
| --- |
| 19150-4service:GeoWebServiceLifeCycle |
| The code values for GeoWebServiceLifeCycle shall include the following values which are further described in 5.2.7.3:<br><br>— register;<br><br>— discovery;<br><br>— view;<br><br>— download;<br><br>— invoke;<br><br>— orchestrationAndComposition; and<br><br>— securityAndRightsManagement. |

### 5.2.7.3 Code values

Table 21 sets the code values for GeoWeb service lifecycle.

**Table 21 — GeoWeb service lifecycle code values**

| Code value | Semantics |
| --- | --- |
| register | Describing and publishing resources. |
| discovery | Searching and discovery of resources. |
| view | Visualizing of resources. |
| download | Downloading and exchanging resources. |
| invoke | Interacting with resources. |
| orchestrationAndComposition | Providing aggregated resources including, in particular, work-flows for service composition. |
| securityAndRightsManagement | Managing access rights to resources. |

### 5.2.8 Service parameters

### 5.2.8.1 Semantics

The class ServiceParameters provides the parameters, input, output, preconditions and results of the GeoWeb service.

NOTE     A GeoWeb service can have preset parameters and delivering results only.

### 5.2.8.2 Requirements

Table 22 lists the requirements for the service parameters.

**Table 22 — Service parameters requirements**

| Requirement |
| --- |
| 19150-4service:ServiceParameters |
| Service parameters shall be described with the following properties which are further described in 5.2.8.3: <br>— parameter; <br>— input; <br>— output; <br>— precondition; and <br>— result. |

#### 5.2.8.3   Properties

Table 23 sets the properties for the description of service parameters.

**Table 23 — Service parameters properties**

| Name | Semantics | Multiplicity | Range |
| --- | --- | --- | --- |
| parameter | One numerical or measurable factor setting conditions of the GeoWeb service operation. | 0..* | CharacterString |
| input | Information (parameter) that the process requires for the GeoWeb service execution. | 0..* | CharacterString |
| output | Something produced by the GeoWeb Service. | 0..* | CharacterString |
| precondition | Condition that is true to perform the GeoWeb service. | 0..* | CharacterString |
| result | Outcome of the GeoWeb service. | 1..* | CharacterString |

### 5.2.9   Service cost

#### 5.2.9.1   Semantics

The union class ServiceCost is used to describe the cost of the GeoWeb service.

#### 5.2.9.2   Requirements

Table 24 lists the requirements for the service cost.

**Table 24 — Service cost requirements**

| Requirement |
| --- |
| 19150-4service:ServiceParameters |
| Service cost shall be described with either one of the following properties which are further described in 5.2.9.3: <br>— monetaryUnitCost; or <br>— complexCost. |

#### 5.2.9.3   Properties

Table 25 sets the properties for the description of service parameters.

**Table 25 — Service cost properties**

| Name | Semantics | Multiplicity | Range |
|---|---|---|---|
| monetaryUnitCost | Amount of money requested for accessing the GeoWeb service.<br><br>NOTE  If the service is free, the value is set to 0. | 1..1 | Currency |
| complexCost | Account of the charging cost for the GeoWeb service including charging styles (e.g. per request or delivery, per unit of measure or granularity etc.), aspects of settlement like the settlement model (transactional vs. rental) and a settlement contract, payment obligations and payment instruments. | 1..1 | CharacterString |

## 5.3  GeoWeb service capabilities

### 5.3.1  General

The requirements for the capabilities of GeoWeb services are listed in Table 26 and illustrated in UML in Figure 4.

**Table 26 — Requirements class for capabilities**

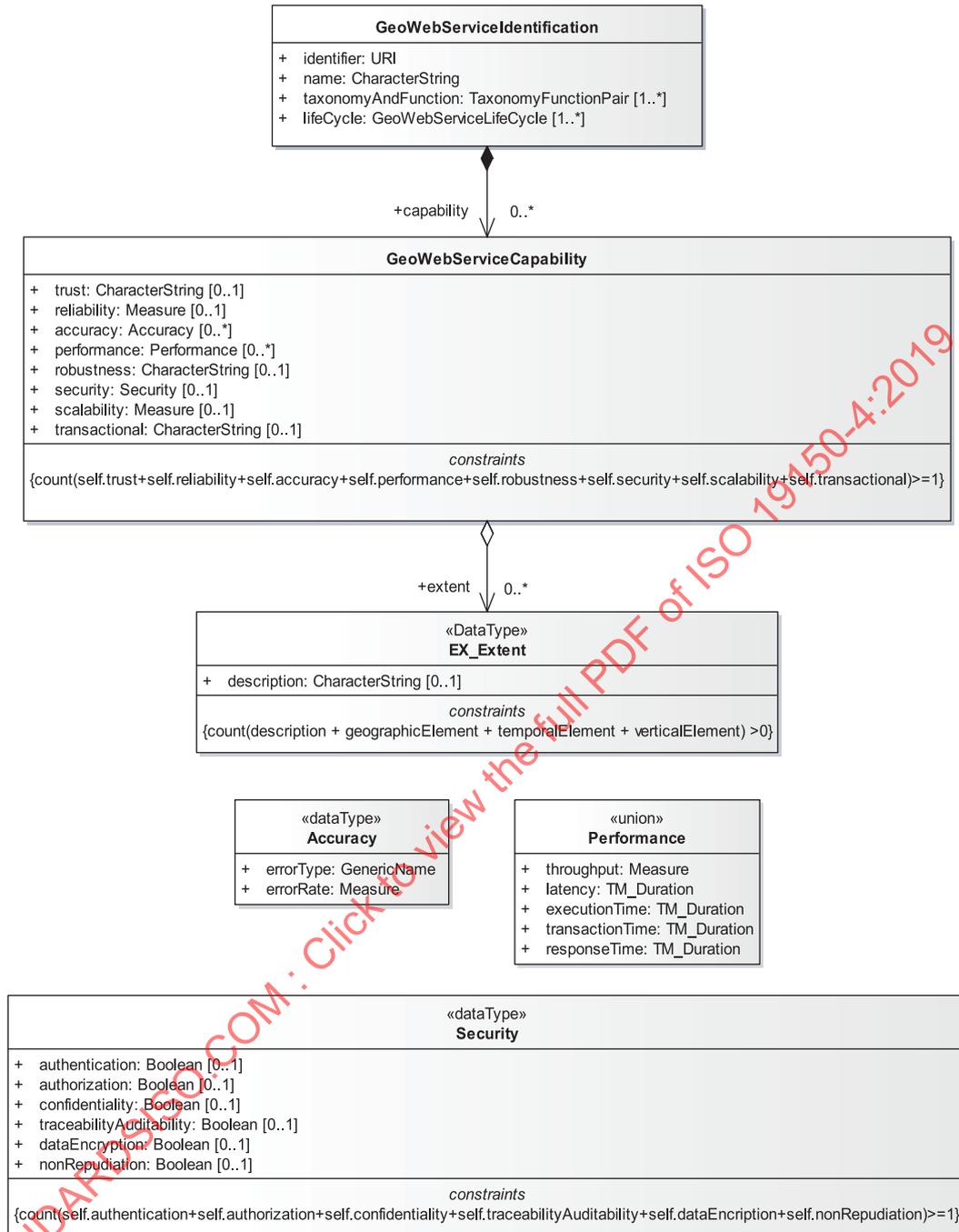| Requirements class | |
|---|---|
| 19150-4capabilities = http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceCapabilities/ | |
| **Target type** | Ontology Framework |
| **Dependency** | http://standards.iso.org/iso/19103/ed-2/en/ (Conceptual schema language) |
| **Dependency** | http://standards.iso.org/iso/19119/ed-2/en/ (Service) |
| **Requirement** | 19150-4capabilities:GeoWebServiceCapability |
| **Requirement** | 19150-4capabilities:Accuracy |
| **Requirement** | 19150-4capabilities:Performance |
| **Requirement** | 19150-4capabilities:Security |

**Figure 4 — UML diagram for GeoWeb service capabilities**

### 5.3.2    GeoWeb service capability

#### 5.3.2.1    Semantics

The class GeoWebServiceCapability provides abilities of the services.

#### 5.3.2.2    Requirements

Table 27 lists the requirements for GeoWeb service capability description.

**Table 27 — GeoWeb service capability requirements**

| Requirement |
| --- |
| 19150-4capabilities:GeoWebServiceCapability |
| If capabilities are provided, GeoWeb service identification shall be associated via a composition association to the class GeoWebServiceCapability with the association role *capability*. Multiple capabilities shall be possible to describe.<br><br>A GeoWeb service capability shall be described with at least one the following properties which are further described in 5.3.2.3:<br><br>— trust;<br><br>— reliability;<br><br>— accuracy;<br><br>— performance;<br><br>— robustness;<br><br>— security;<br><br>— transactional; and<br><br>— extent. |

#### 5.3.2.3 Properties

Table 28 sets the additional property to GeoWebServiceIdentification.

**Table 28 — Additional GeoWeb service properties**

| Name | Semantics | Multiplicity | Range |
| --- | --- | --- | --- |
| capability (role) | Abilities of the GeoWeb service. | 0..* | GeoWebServiceCapability |

Table 29 sets the properties for the description of capabilities of GeoWeb services.

**Table 29 — GeoWeb service capability properties**

| Name | Semantics | Multiplicity | Range |
| --- | --- | --- | --- |
| trust | Trustworthiness of the GeoWeb service. | 0..1 | CharacterString |
| reliability | Ability of a GeoWeb service to perform its functions (to maintain its Web service quality), measured by the number of failures of the GeoWeb service in a certain time interval. | 0..1 | Measure |
| accuracy | Error rate generated by the GeoWeb service. | 0..* | Accuracy |
| performance | How fast a GeoWeb service request is completed, measured in terms of throughput, latency, execution time, transaction time, or response time. | 0..* | Performance |
| robustness | Ability of the GeoWeb service to function correctly in the presence of incomplete or invalid inputs. | 0..1 | CharacterString |

**Table 29** *(continued)*

| Name | Semantics | Multiplicity | Range |
|------|-----------|--------------|-------|
| security | Ability of a GeoWeb service to provide authentication, authorization, confidentiality, traceability/auditability, data encryption, and non-repudiation. | 0..1 | Security |
| scalability | Ability of the Web service to process more requests in a certain time interval, measured by the number of solved requests in a certain time interval. | 0..1 | Measure |
| transactional | Transactional properties of the Web service. | 0..1 | CharacterString |
| extent (role) | Extent, scope, or coverage of the GeoWeb service. | 0..* | EX_Extent |

### 5.3.3 Accuracy

#### 5.3.3.1 Semantics

The datatype Accuracy provides the identification and quantification of errors generated by the GeoWeb service.

#### 5.3.3.2 Requirements

Table 30 lists the requirements for accuracy description.

**Table 30 — Accuracy description requirements**

| Requirement |
|-------------|
| 19150-4capabilities:Accuracy |
| Accuracy shall be described with the following properties which are further described in clause 5.3.3.3:<br>— errorType; and<br>— errorRate. |

#### 5.3.3.3 Properties

Table 31 sets the properties for the description of accuracy.

**Table 31 — Accuracy properties**

| Name | Semantics | Multiplicity | Range |
|------|-----------|--------------|-------|
| errorType | Kind of error generated by the GeoWeb service. | 1..1 | GenericName |
| errorRate | Rate of error generated by the GeoWeb service. | 1..1 | Measure |

### 5.3.4 Performance

#### 5.3.4.1 Semantics

The union class Performance provides a measure in terms of throughput, latency, execution time, transaction time, or response time about the operation of the GeoWebService.

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### 5.3.4.2 Requirements

Table 32 lists the requirements for performance description.

**Table 32 — Performance requirements**

| Requirement |
| --- |
| 19150-4capabilities:Performance |
| Performance shall be described with either one of the following properties which are further described in 5.3.4.3:<br>— throughput;<br>— latency;<br>— executionTime;<br>— transactionTime; and<br>— responseTime. |

### 5.3.4.3 Properties

Table 31 sets the properties for the description of performance.

**Table 33 — GeoWeb service capability properties**

| Name | Semantics | Multiplicity | Range |
| --- | --- | --- | --- |
| throughput | Number of units of information a GeoWeb service can process in a given amount of time measured in bits per second (bps), in megabits per second (Mbps) or in gigabits per second (Gbps). | 1..1 | Measure |
| latency | Delay from input into a GeoWeb Service to desired outcome. Latency measurement starts at the instant when the GeoWeb service is invoked and ends on the return of the response from the GeoWeb service. | 1..1 | TM_Duration |
| executionTime | The maximum length of time the GeoWeb service requires to perform the task. | 1..1 | TM_Duration |
| transactionTime | Time required to exchange a sequence of information with the related work (such as database updating) that is treated as a unit for the purposes of satisfying a request and for ensuring database integrity. | 1..1 | TM_Duration |
| responseTime | Elapsed time between the end of an inquiry or demand on a GeoWeb service and the beginning of a response. | 1..1 | TM_Duration |

### 5.3.5 Security

#### 5.3.5.1 Semantics

The datatype Security provides the ability of a GeoWeb service to provide authentication, authorization, confidentiality, traceability/auditability, data encryption, and non-repudiation.

#### 5.3.5.2 Requirements

Table 34 lists the requirements for security capabilities.

**Table 34 — Security capability requirements**

| Requirement |
|---|
| 19150-4capabilities:Security |
| Security capabilities shall be provided with at least one of the following properties which are further described in 5.3.5.3:<br><br>— authentication;<br><br>— authorization;<br><br>— confidentiality;<br><br>— traceabilityAuditability;<br><br>— dataEncryption; and<br><br>— nonRepudiation. |

#### 5.3.5.3 Properties

Table 35 sets the properties for the security capabilities.

**Table 35 — Security service capabilities**

| Name | Semantics | Multiplicity | Range |
|---|---|---|---|
| authentication | Ability of a GeoWeb service to provide authentication. | 0..1 | Boolean |
| authorization | Ability of a GeoWeb service to provide authorization. | 0..1 | Boolean |
| confidentiality | Ability of a GeoWeb service to provide confidentiality. | 0..1 | Boolean |
| traceabilityAuditability | Ability of a GeoWeb service to provide traceability/auditability. | 0..1 | Boolean |
| dataEncryption | Ability of a GeoWeb service to provide data encryption. | 0..1 | Boolean |
| nonRepudiation | Ability of a GeoWeb service to provide non-repudiation. | 0..1 | Boolean |

### 5.4 GeoWeb service metadata

#### 5.4.1 General

The requirements for the metadata of GeoWeb services are listed in Table 36 and illustrated in UML in Figure 5.

**Table 36 — Requirements class for metadata**

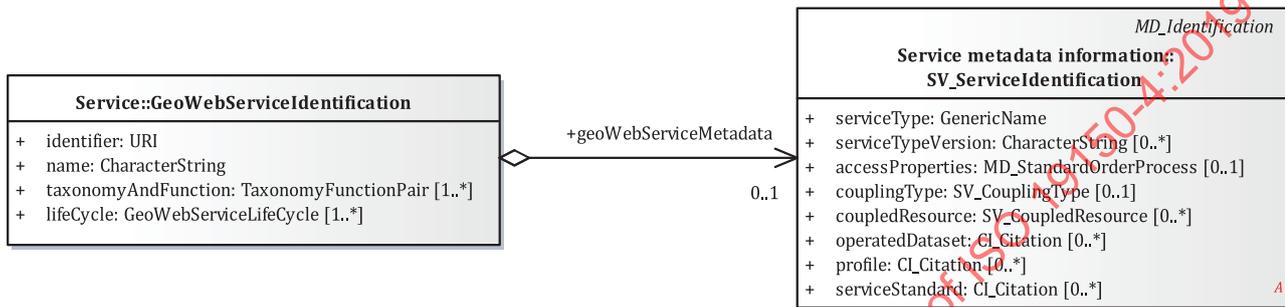| Requirements class | |
|---|---|
| 19150-4metadata = http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceMetadata/ | |
| **Target type** | Ontology Framework |
| **Dependency** | http://standards.iso.org/iso/19103/ed-2/en/ (Conceptual schema language) |
| **Dependency** | http://standards.iso.org/iso/19119/ed-2/en/ (Service) |
| **Requirement** | 19150-4metadata: GeoWebServiceMetadata |



**Figure 5 — UML diagram for GeoWeb service metadata**

### 5.4.2 GeoWeb service metadata

#### 5.4.2.1 Semantics

The association role *geoWebServiceMetadata* enables providing metadata of the GeoWeb service.

#### 5.4.2.2 Requirements

Table 37 lists the requirements for GeoWeb service metadata description.

**Table 37 — GeoWeb service metadata requirements**

| Requirement |
|---|
| 19150-4metadata:GeoWebServiceMetadata |
| If metadata are provided, GeoWebService shall be associated via an aggregation association to the class SV_ServiceIdentification (ISO 19115-1) with the association role *geowebServiceMetadata*. |

#### 5.4.2.3 Properties

Table 38 sets the additional property to GeoWebServiceIdentification.

**Table 38 — Additional GeoWeb service properties**

| Name | Semantics | Multiplicity | Range |
|---|---|---|---|
| geowebServiceMetadata (role) | Metadata of the GeoWeb service. | 0..1 | SV_ServiceIdentification |

# 6 OWL ontology of GeoWeb service

## 6.1 General

Clause 6 sets the requirements for the OWL[1] representation of the GeoWeb service ontology framework.

The requirements for the OWL representation of the GeoWeb service ontology framework are listed in Table 39.

**Table 39 — Requirements class for OWL representation of the GeoWeb service ontology framework**

| Requirements class | |
|---|---|
| 19150-4owl = http://standards.isotc211.org/iso19150/-4/1/req/geowebServiceOwl/ | |
| **Target type** | OWL Ontology |
| **Dependency** | http://standards.iso.org/iso/19150-2/ed-1/en/ (Rules for developing ontologies in the Web Ontology Language (OWL)) – Clause 6 |
| **Dependency** | 19150-4service |
| **Dependency** | 19150-4capabilities |
| **Dependency** | 19150-4metadata |
| **Requirement** | 19150-4owl:service |
| **Requirement** | 19150-4owl:capabilities |
| **Requirement** | 19150-4owl:metadata |

## 6.2 Service requirements

The requirements for the representations of the GeoWeb service identification and description in OWL syntax are listed in Table 40.

---

1) RDF, which stands for *Resource Description Framework*, is a formal language meant for the description of structure information for their exchange on the Web and preserving their meaning[3]. RDFS (i.e. *RDF Schema*) has been further introduced to specify user-defined vocabulary. However, RDFS capabilities is limited for simple ontologies. OWL (the *Web Ontology language*) is meant for complex knowledge modelling and expressive representation language based on formal logic. It enables logical reasoning. OWL remains an RDF compliant document.

**Table 40 — Requirements for the OWL representation of GeoWeb service identification and description**

| Requirement |
|---|
| 19150-4owl:service |
| A specific OWL ontology shall encompass the OWL classes and properties required for the representation of GeoWeb service identification and description as specified in the requirements:<br><br>— 19150-4service:GeoWebServiceIdentification;<br><br>— 19150-4service:GeoWebServiceDescription;<br><br>— 19150-4service:TaxonomyAndFunction;<br><br>— 19150-4service:GeoWebServiceTaxonomy;<br><br>— 19150-4service:GeoWebServiceFunction;<br><br>— 19150-4service:GeoWebServiceLifeCycle;<br><br>— 19150-4service:ServiceParameters;<br><br>— 19150-4service:SubjectCode; and<br><br>— 19150-4service:ServiceCost.<br><br>The OWL ontology shall comply with ISO 19150-2:2015, Clause 6. |

## 6.3 Capability requirements

The requirements for the representations of the GeoWeb service capabilities in OWL syntax are listed in Table 41.

**Table 41 — Requirements for the OWL representation of GeoWeb service capabilities**

| Requirement |
|---|
| 19150-4owl:capability |
| A specific OWL ontology shall encompass the OWL classes and properties required for the representation of GeoWeb service capabilities as specified in the requirements:<br><br>— 19150-4capabilities:GeoWebServiceCapability;<br><br>— 19150-4capabilities:Accuracy;<br><br>— 19150-4capabilities:Performance;<br><br>— 19150-4capabilities:Security; and<br><br>— 19150-4capabilities:ErrorTypeCode.<br><br>The OWL ontology shall comply with ISO 19150-2:2015, Clause 6. |
| The OWL ontology shall define a *capability* object property that has the corresponding GeoWeb service identification class for domain (see requirement 19150-4owl:service) and the corresponding GeoWeb service capability class for range. Appropriate property restrictions to the GeoWeb service identification class shall be set for the values (owl:allValuesFrom) and cardinalities. |

## 6.4 Metadata requirements

The requirements for the representations of the GeoWeb service metadata in OWL syntax are listed in Table 42.

**Table 42 — Requirements for the OWL representation of GeoWeb service metadata**

| Requirement |
|---|
| 19150-4owl:metadata |
| A specific OWL ontology shall be set to support the requirement 19150-4metadata:GeoWebServiceMetadata. |
| The OWL ontology shall comply with ISO 19150-2:2015, Clause 6. |
| The OWL ontology shall define a *geoWebServiceMetadata* object property that has the corresponding GeoWeb service identification class for domain (see requirement 19150-4owl:service) and the corresponding. SV_ServiceIdentification[a] class for range. Appropriate property restrictions to the GeoWeb service identification class shall be set for the values (owl:allValuesFrom) and cardinalities. |
| [a]    From the OWL ontology derived from ISO 19115-1:2014, 6.5.14. |

# Annex A
## (normative)

# Abstract test suite

## A.1 Conformance classes

Annex A describes tests corresponding to each requirement. They are packaged in four conformance classes:

— Conformance class for the framework:

— Geographic information Web service identification and description

— 19150-4service-conf = http://standards.isotc211.org/iso19150/ -4/1/conf/geowebServiceIdentificationAndDescription/

— Geographic information Web service capabilities

— 19150-4capabilities-conf = http://standards.isotc211.org/iso19150/ -4/1/conf/geowebServiceCapabilities/

— Geographic information Web service metadata

— 19150-4metadata-conf = http://standards.isotc211.org/iso19150/ -4/1/conf/geowebServiceMetadata/

— Conformance class for service ontology in OWL:

— Geographic information Web service Ontology

— 19150-4owl-conf = http://standards.isotc211.org/iso19150/-4/1/conf/owl/

The conformance class Geographic information Web service identification and description (19150-4service-conf) includes the following tests:

— GeoWeb service identification (see A.2.1);

— GeoWeb service description (see A.2.2);

— Taxonomy and function (see A.2.3);

— GeoWeb service taxonomy (see A.2.4);

— GeoWeb service function (see A.2.5);

— GeoWeb service lifecycle (see A.2.6);

— Service parameters (see A.2.7);

— Service cost (see A.2.8).

The conformance class Geographic information Web service capabilities (19150-4capabilities-conf) includes the following tests:

— GeoWeb service capability (see A.3.1);

— Accuracy (see A.3.2);

— Performance (see A.3.3);

— Security (see A.3.4).

The conformance class Geographic information Web service metadata (19150-4metadata-conf) includes the following tests:

— GeoWeb service metadata (see A.4.1).

The conformance class Geographic information Web service Ontology (19150-4owl-conf) includes the following tests:

— Service (see A.5.1);

— Capabilities (see A.5.2);

— Metadata (see A.5.3).

## A.2 Geographic information Web service identification and description

### A.2.1 GeoWeb service identification

The test 19150-4service-conf:GeoWebServiceIdentification for "GeoWeb service identification" is as follows:

a) Test purpose Verify that the implementation of the GeoWeb service ontology framework contains a class for the identification of a GeoWeb Service. Verify that the class includes the properties *identifier*, *name*, *taxonomyAndFunction*, and *lifecycle*, and the association role *description in compliance with* Table 3.

b) Test method Inspect the implementation of the GeoWeb service ontology framework and more specifically the container (e.g. structure, class, etc.) corresponding to the identification of a GeoWeb Service. Inspect if the properties are set appropriately.

c) Reference Requirement 19150-4service:GeoWebServiceIdentification (5.2.2).

d) Test type Capability test.

### A.2.2 GeoWeb service description

The test 19150-4service-conf:GeoWebServiceDescription for "GeoWeb service description" is as follows:

a) Test purpose Verify that the implementation of the GeoWeb service ontology framework contains a class for the description of a GeoWeb Service. Verify that the class includes the properties *description*, *subject*, *version*, *date*, *language*, *source*, *contact*, *rights*, *cost*, and *url*, and the association roles *parameters* and *ServiceChainingInformation*, in compliance with Table 5.

b) Test method Inspect the implementation of the GeoWeb service ontology framework and more specifically the container (e.g. structure, class, etc.) corresponding to the description of a GeoWeb Service. Inspect if the properties are set appropriately.

c) Reference Requirement 19150-4service:GeoWebServiceDescription (5.2.3).

d) Test type Capability test.

### A.2.3  Taxonomy and function

The test 19150-4service-conf:TaxonomyAndFunction for "Taxonomy and function" is as follows:

a)  Test purpose     Verify that the implementation of the GeoWeb service ontology framework contains a class for the identification of taxonomy and function. Verify that the class includes the properties *taxonomy* and *function*, in compliance with Table 7. Verify that the values of the function property are synchronized properly with the value of the taxonomy property as required in Table 6.

b)  Test method     Inspect the implementation of the GeoWeb service ontology framework and more specifically the container (e.g. structure, class, etc.) corresponding to the depiction of the taxonomy and function of a GeoWeb Service. Inspect if the properties are set appropriately. Inspect if the synchronization between the properties is set correctly.

c)  Reference     Requirement 19150-4service:TaxonomyAndFunction (5.2.4).

d)  Test type     Capability test.

### A.2.4  GeoWeb service taxonomy

The test 19150-4service-conf:GeoWebServiceTaxonomy for "GeoWeb service taxonomy" is as follows:

a)  Test purpose     Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the taxonomy values compliant with Table 9.

b)  Test method     Inspect the implementation of the GeoWeb service ontology framework and more specifically the container (e.g. structure, class, etc.) that sets the list of values for taxonomy depiction of a GeoWeb Service. Inspect if the list of values is complete.

c)  Reference     Requirement 19150-4service:GeoWebServiceTaxonomy (5.2.5).

d)  Test type     Capability test.

### A.2.5  GeoWeb service function

The test 19150-4service-conf:GeoWebServiceFunction for "GeoWeb service function" is as follows:

a)  Test purpose     Verify that the implementation of the GeoWeb service ontology framework contains a root codelist for the function values that is subtyped by the codelists *GeoWebBoundaryHumanInteractionServiceFunction*, *GeoWebModelInformationManagementFunction*, *GeoWebWorkflowTaskManagementFunction*, *GeoWebProcessingFunction*, *GeoWebCommunicationFunction*, and *GeoWebSystemManagementSecurityFunction*.

    Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the boundary human interaction service function values compliant with Table 11.

    Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the model information management function values compliant with Table 12.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the workflow task management function values compliant with Table 13.

Verify that the implementation of the GeoWeb service ontology framework contains a root codelist for the processing function values that is subtyped by the codelists *GeoWebProcessingSpatialFunction*, *GeoWebProcessingThematicFunction*, *GeoWebProcessingTemporalFunction*, and *GeoWebProcessingMetadataFunction*.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the spatial processing function values compliant with Table 14.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the thematic processing function values compliant with Table 15.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the temporal processing function values compliant with Table 16.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the metadata processing function values compliant with Table 17.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the communication function values compliant with Table 18.

Verify that the implementation of the GeoWeb service ontology framework contains a codelist of the system management security function values compliant with Table 19.

b) Test method    Inspect the implementation of the GeoWeb service ontology framework and more specifically the various containers (e.g. structure, class, etc.) that set the lists of values for function depiction of a GeoWeb Service (i.e. *GeoWebBoundaryHumanInteractionServiceFunction*, *GeoWebModelInformationManagementFunction*, *GeoWebWorkflowTaskManagementFunction*, *GeoWebProcessingFunction*, *GeoWebProcessingSpatialFunction*, *GeoWebProcessingThematicFunction*, *GeoWebProcessingTemporalFunction*, *GeoWebProcessingMetadataFunction*, *GeoWebCommunicationFunction*, and *GeoWebSystemManagementSecurityFunction*) and their subtyping relationships. Inspect if the lists of values are complete.

c) Reference    Requirement 19150-4service:GeoWebServiceFunction (5.2.6).

d) Test type    Capability test.

### A.2.6   GeoWeb service lifecycle

The test 19150-4service-conf:GeoWebServiceLifeCycle for "GeoWeb service lifecycle" is as follows:

a)  Test purpose       Verify that the implementation of the GeoWeb service ontology framework con-
                       tains a codelist of the service life cycle values compliant with Table 21.

b)  Test method        Inspect the implementation of the GeoWeb service ontology framework and more
                       specifically the container (e.g. structure, class, etc.) corresponding to the lifecycle
                       of a GeoWeb Service. Inspect if the properties are set appropriately.

c)  Reference          Requirement 19150-4service:GeoWebServiceLifeCycle (5.2.7).

d)  Test type          Capability test.

### A.2.7   Service parameters

The test 19150-4service-conf:ServiceParameters for "Service parameters" is as follows:

a)  Test purpose       Verify that the implementation of the GeoWeb service ontology framework
                       contains a class for the identification of the service parameters. Verify that the
                       class includes the properties *parameter*, *input*, *output*, *precondition*, and *result*, in
                       compliance with Table 23.

b)  Test method        Inspect the implementation of the GeoWeb service ontology framework and more
                       specifically the container (e.g. structure, class, etc.) corresponding to the service
                       parameters of a GeoWeb Service. Inspect if the properties are set appropriately.

c)  Reference          Requirement 19150-4service:ServiceParameters (5.2.8).

d)  Test type          Capability test.

### A.2.8   Service cost

The test 19150-4service-conf::ServiceCost for "Service cost" is as follows:

a)  Test purpose       Verify that the implementation of the GeoWeb service ontology framework con-
                       tains a class for the identification of the service cost. Verify that the class includes
                       the properties *monetaryUnitCost* and *complexCost*, in compliance with Table 25.

b)  Test method        Inspect the implementation of the GeoWeb service ontology framework and more
                       specifically the container (e.g. structure, class, etc.) corresponding to the service
                       cost of a GeoWeb Service. Inspect if the properties are set appropriately.

c)  Reference          Requirement 19150-4service:ServiceCost (5.2.9).

d)  Test type          Capability test.