INTERNATIONAL STANDARD

ISO 19143

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Geographic information — Filter encoding

Information géographique — Codage de filtres

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Foreword

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

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

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

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ISO 19143 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*, in collaboration with the Open Geospatial Consortium Inc. (OGC).

Introduction

Filter encoding was originated within the OGC.

A fundamental operation performed on a set of data or resources is that of querying in order to obtain a subset of the data which contains certain desired information that satisfies some query criteria and which is also, perhaps, sorted in some specified manner.

The term “projection clause” is used to describe an encoding for specifying which subset of resource properties are presented in the response to a query.

The term “filter or selection clause” is used to describe an encoding of predicates which are typically used in query operations to specify how data instances in a source dataset should be filtered to produce a result set. Each data instance in the source set is evaluated using the filter expression. The overall filter expression always evaluates to true or false. If the expression evaluates to true, the data instance satisfies the expression and is marked as being in the result set. If the overall filter expression evaluates to false, the data instance is not in the result set. Thus, the net effect of evaluating a filter expression is a set of data or resource identifiers which satisfy the predicates in the expression.

The term “sorting clause” is used to describe an encoding for specifying how the data in a response is ordered prior to being presented.

Such encodings are considered system neutral because using the numerous XML tools available today, XML encoded projection, selection and sorting clauses can be easily validated, parsed and then transformed into whatever target query language is required to retrieve or modify resources stored in some persistent object store. For example an XML encoded query composed of a projection, selection and sorting clauses can be transformed into a SQL “SELECT … FROM … WHERE … ORDER BY …” statement to fetch data stored in a SQL-based relational database. Similarly, the same XML encoded query expression can just as easily be transformed into an XQuery expression in order to retrieve data from XML document.

The XML and KVP encodings of projection, selection and sorting clauses described in this International Standard are common components which can be used together or as individually by a number of web services. Any service that requires the ability to query objects from a web-accessible repository can make use of the XML and KVP encodings of a query expression described in this International Standard. For example the GetFeature operation, defined in ISO 19142, uses the elements derived from definitions in this International Standard to encode query expressions.

Geographic information — Filter encoding

1 Scope

This International Standard describes an XML and KVP encoding of a system neutral syntax for expressing projections, selection and sorting clauses collectively called a query expression.

These components are modular and intended to be used together or individually by other standards which reference this International Standard.

EXAMPLE 1 ISO 19142 makes use of some or all of these components.

This International Standard defines an abstract component, named AbstractQueryExpression, from which other specifications can subclass concrete query elements to implement query operations.

This International Standard also defines an additional abstract query component, named AbstractAdhocQueryExpresison, which is derived from AbstractQueryExpression and from which other specifications can subclass concrete query elements which follow the following query pattern:

> An abstract query element from which service specifications can subclass a concrete query element that implements a query operation that allows a client to specify a list of resource types, an optional projection clause, an optional selection clause, and an optional sorting clause to query a subset of resources that satisfy the selection clause.

This pattern is referred to as an ad hoc query pattern since the server is not aware of the query until it is submitted for processing. This is in contrast to a stored query expression, which is stored and can be invoked by name or identifier.

This International Standard also describes an XML and KVP encoding of a system-neutral representation of a select clause. The XML representation is easily validated, parsed and transformed into a server-specific language required to retrieve or modify object instances stored in some persistent object store.

EXAMPLE 2 An XML encoded filter can be transformed into a WHERE clause for a SQL SELECT statement to fetch data stored in a SQL-based relational database. Similarly, and XML encoded filter expression can be transformed into an XPath or XPointer expression for fetching data from XML documents.

This International Standard defines the XML encoding for the following predicates.

a) A standard set of logical predicates: and, or and not.

b) A standard set of comparison predicates: equal to, not equal to, less than, less than or equal to, greater than, greater than or equal to, like, is null and between.

c) A standard set of spatial predicates: equal, disjoint, touches, within, overlaps, crosses, intersects, contains, within a specified distance, beyond a specified distance and BBOX.

d) A standard set of temporal predicates: after, before, begins, begun by, contains, during, ends, equals, meets, met by, overlaps and overlapped by.

e) A predicate to test whether the identifier of an object matches the specified value.

This International Standard defines the XML encoding of metadata that allows a service to declare which conformance classes, predicates, operators, operands and functions it supports. This metadata is referred to as Filter Capabilities.

2 Conformance

Few usage scenarios require the full implementation of this International Standard to work. Therefore, service providers may want to specify requirements for only the subset needed to fulfil their service. Or system developers may want to document which subset of this International Standard it is that that they have implemented and conform to. These named conformance classes help in specifying such subsets.

This International Standard defines conformance classes based on the operations and behaviour that a filter encoding service claims to implement. Table 1 indicates which behaviour shall be implemented for each of the conformance classes. The described behaviour shall be implemented for the corresponding conformance class, and the name of the paragraph of the actual detailed abstract test suite in Annex A.

Table 1 — FE conformance classes

Conformance class name	Operation or behaviour	Subclause of the abstract test suite
Query	Service that references this International Standard materializes a concrete query element that is substitutable for fes:AbstractQueryElement.	A.1
Ad hoc Query	Service that references this International Standard materializes a concrete query element that is substitutable for fes:AbstractAdhocQueryElement and materializes a concrete selection clause element that is substitutable for fes:AbstractSelectionClause and materializes a concrete projection clause element that is substitutable for fes:AbstractProjectionClause and materializes a concrete sorting clause element that is substitutable for fes:AbstractSortingClause.	A.2
Functions	Implements functions that are in addition to the operators defined in this International Standard.	A.3
Resource Identification	Implements the ResourceId operator with the rid parameter to allow predicates to be written that allow a specific resource to be queried.	A.4
Minimum Standard Filter	Implements the comparison operators: PropertyIsEqualTo, PropertyIsNotEqualTo, PropertyIsLessThan, PropertyIsGreaterThan, PropertyIsLessThanOrEqualTo, PropertyIsGreaterThanOrEqualTo. Implements the logical operators. Does not implement any additional functions.	A.5
Standard Filter	Implements all the comparison and logical operators and may implement one or more additional functions.	A.6
Minimum Spatial Filter	Implements only the BBOX spatial operator.	A.7
Spatial Filter	Implements the BBOX spatial operator and one or more of the other spatial operators.	A.8
Minimum Temporal Filter	Implements only the During temporal operator.	A.9
Temporal Filter	Implements the During temporal operator and one or more of the other temporal operators.	A.10
Version navigation	Implements ResourceId operator with the parameters that allow versions of resources to be queried (version, startTime, endTime).	A.11
Sorting	Implements sorting of the resources in a response.	A.12
Extended Operators	Implements additional operators not defined in this International Standard.	A.13
Minimum XPath	Implements the minimum required set of XPath capabilities.	A.14
Schema Element Function	Implements the schema-element() XPath function.	A.15

Other standards that include this International Standard shall declare what constitutes a “minimum” filter by declaring the minimum set of conformance classes from Table 1 that shall be implemented.

3 Normative references

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

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

ISO 19125-1:2004, *Geographic information — Simple feature access — Part 1: Common architecture*

ISO 19136:2007, *Geographic information — Geography Markup Language (GML)*

IETF RFC 2396, *Uniform Resource Identifiers (URN): Generic Syntax* (August 1998)

OGC 06-121r3, *OGC Web Services Common Specification*, OGC® Implementation Specification (9 February 2009)

W3C XML, *Extensible Markup Language (XML) 1.0 (Third edition)*, W3C Recommendation (4 February 2004)

W3C XML, *Namespaces, Namespaces in XML*, W3C Recommendation (14 January 1999)

W3C XML, *Path Language, XML Path Language (XPath) 2.0*, W3C Recommendation (23 January 2007)

W3C XML, *Schema Part 1, XML Schema Part 1: Structures*, W3C Recommendation (2 May 2001)

W3C XML, *Schema Part 2, XML Schema Part 2: Datatypes*, W3C Recommendation (2 May 2001)

4 Terms and definitions

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

4.1
attribute
⟨XML⟩ name-value pair contained in an **element**

[ISO 19136:2007, definition 4.1.3]

NOTE In this International Standard, an attribute is an XML attribute unless otherwise specified.

4.2
client
software component that can invoke an **operation** from a **server**

[ISO 19128:2005, definition 4.1]

4.3
coordinate
one of a sequence of n numbers designating the position of a point in n-dimensional space

[ISO 19111:2007, definition 4.5]

4.4
coordinate reference system
coordinate system that is related to an object by a datum

[ISO 19111:2007, definition 4.8]

4.5
coordinate system
set of mathematical rules for specifying how **coordinates** are to be assigned to points

[ISO 19111:2007, definition 4.10]

4.6
element
〈XML〉 basic information item of an XML document containing child elements, **attributes** and character data

[ISO 19136:2007, definition 4.1.23]

4.7
feature
abstraction of real world phenomena

[ISO 19101:2002, definition 4.11]

NOTE A feature can occur as a type or an instance. It is intended that the term “feature type” or “feature instance” be used when only one is meant.

4.8
feature identifier
identifier that uniquely designates a **feature** instance

[ISO 19142:2010, definition 4.8]

4.9
feature reference
Uniform Resource Identifier that identifies a **feature**

4.10
filter capabilities XML
metadata, encoded in XML, that describes which **predicates** defined in this International Standard a system implements

4.11
filter expression
predicate expression encoded using XML

4.12
filter expression processor
component of a system that processes a **filter expression**

4.13
function
rule that associates each **element** from a domain (source, or domain of the function) to a unique element in another domain (target, co-domain, or range)

[ISO 19107:2003, definition 4.41]

4.14
interface
named set of **operations** that characterize the behaviour of an entity

[ISO 19119:2005, definition 4.2]

4.15
literal value
constant, explicitly specified value

NOTE This contrasts with a value that is determined by resolving a chain of substitution (e.g. a variable).

4.16
join predicate
filter expression that includes one or more clauses that constrain properties from two different entity types

NOTE In this International Standard, the entity types are **resource** types.

4.17
namespace
⟨XML⟩ collection of names, identified by a URI reference which are used in XML documents as **element** names and **attribute** names

[W3C XML Namespaces]

4.18
operation
specification of a transformation or query that an object may be called to execute

[ISO 19119:2005, definition 4.3]

4.19
predicate
set of computational **operations** applied to a data instance which evaluate to true or false

4.20
predicate expression
formal syntax for describing a **predicate**

4.21
property
facet or **attribute** of an object referenced by a name

4.22
request
invocation of an **operation** by a **client**

[ISO 19128:2005, definition 4.10]

4.23
resource
asset or means that fulfils a requirement

[ISO 19115:2003, definition 4.10]

NOTE In this International Standard, a resource is assumed to have identity.

4.24
response
result of an **operation** returned from a **server** to a **client**

[ISO 19128:2005, definition 4.11]

4.25
service
distinct part of the functionality that is provided by an entity through **interfaces**

[ISO 19119:2005, definition 4.1]

4.26
server
particular instance of a **service**

[ISO 19128:2005, definition 4.12]

4.27
tuple
ordered list of values

[ISO 19136:2007, definition 4.1.63]

NOTE In this International Standard, the ordered list is generally a finite sequence of **resources**.

4.28
Uniform Resource Identifier
URI
unique identifier for a **resource**, structured in conformance with IETF RFC 2396

[ISO 19136:2007, definition 4.1.65]

NOTE The general syntax is <scheme>:<scheme-specified-part>. The hierarchical syntax with a namespace is <scheme>://<authority><path>?<query>.

5 Conventions

5.1 Abbreviated terms

BBOX	Bounding Box
CRS	Coordinate Reference System
EBNF	Extended Backus-Naur Form
EPSG	European Petroleum Survey Group
GML	Geography Markup Language
HTTP	Hypertext Transfer Protocol
HTTPS	Secure Hypertext Transfer Protocol
IETF	Internet Engineering Task Force
KVP	Keyword-value Pair
OGC	Open Geospatial Consortium
SRS	Spatial Reference System
URI	Uniform Resource Identifier
URL	Uniform Resource Locator

URN Uniform Resource Name

UTC Coordinated Universal Time

W3C World Wide Web Consortium

WFS Web Feature Service

XML Extensible Markup Language

5.2 UML notation

5.2.1 Figure 1 describes the Unified Modelling Language (UML) notations used in this International Standard for UML class diagrams.

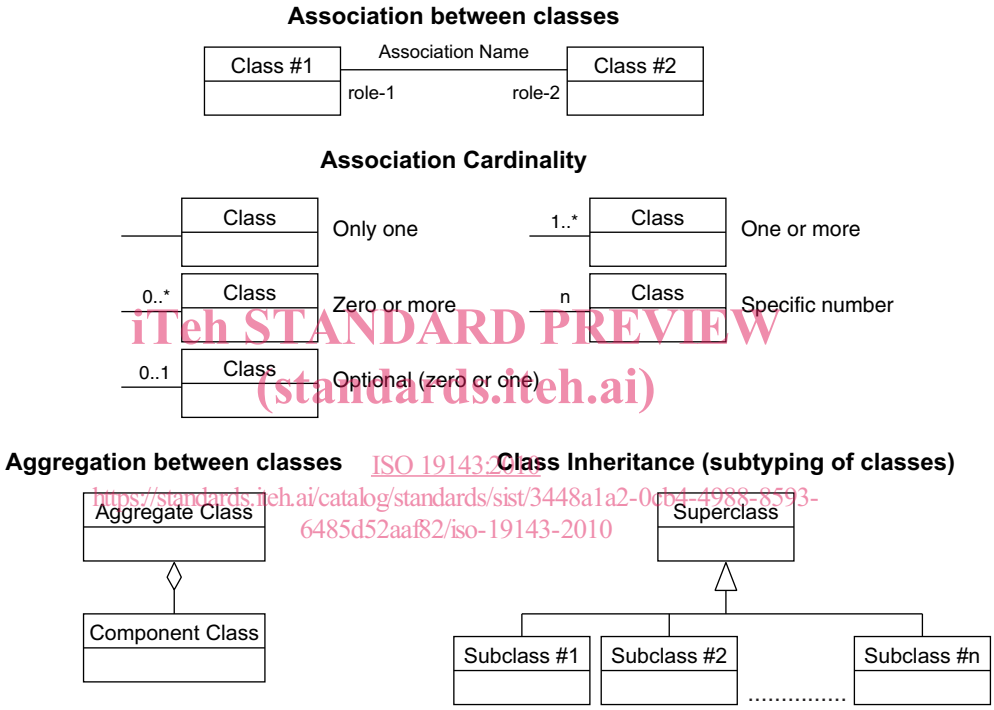

Figure 1 — UML notation in class diagrams

5.2.2 In these class diagrams, the following stereotypes of UML classes are used:

a) <<DataType>> is a descriptor of a set of values that lack identity (independent existence and the possibility of side effects). A DataType is a class with no operations, whose primary purpose is to hold the information.

b) <<Enumeration>> is a data type whose instances form a list of alternative literal values. Enumeration means a short list of well-understood potential values within a class.

c) <<CodeList>> is a flexible enumeration for expressing a long list of potential alternative values. If the list alternatives are completely known, an enumeration shall be used; if the only likely alternatives are known, a code list shall be used.

d) <<Interface>> is a definition of a set of operations that is supported by objects having this interface. An Interface class cannot contain any attributes.

e) <<Type>> is a stereotyped class used for specification of a domain of instances (objects), together with the operations applicable to the objects. A Type class may have attributes and associations.

f) <<Union>> is a list of alternate attributes where only one of those attributes may be present at any time.

See also ISO/TS 19103:2005, 6.8.2 and D.8.3.

5.2.3 In this International Standard, the following standard data types are used:

a) CharacterString is a sequence of characters;

b) LocalisedCharacterString is a CharacterString associated with a locale;

c) Boolean is a value specifying TRUE or FALSE;

d) URI is an identifier of a resource that provides more information;

e) Integer is an integer number.

5.3 Use of examples

This International Standard makes use of XML examples. They are meant to illustrate the various aspects of filters discussed in this International Standard. While every effort has been made to ensure that the examples are well formed and valid, this goal may be sacrificed for the sake of clarity. For instance, many examples are formatted in a specific way to highlight a particular aspect that would render the example invalid from the perspective of an XML validation tool. Furthermore, most examples reference fictitious servers and data.

Thus, this International Standard does not assert that any XML encoded example, copied from this International Standard, would necessarily execute correctly or validate using a particular XML validation tool.

5.4 Namespaces

Namespaces (a specified in W3C XML Namespaces) are used to discriminate XML vocabularies from one another. The following namespaces are normatively used in this International Standard:

a) (http://www.opengis.net/fes/2.0): for the Filter vocabulary;

b) (http://www.opengis.net/gml/3.2): for the GML vocabulary.

5.5 KVP-encoded parameter lists

This International Standard defines both XML and KVP encodings for query and filter expressions. Several of the parameters in the KVP-encoding consist of lists of values (see Table 2) and possibly lists of lists of values. This subclause defines how to encode lists of values as the value of a parameter.

Parameters consisting of lists shall use the comma (“,”) as the delimiter between items in the list. In addition, multiple lists may be specified as the value of a parameter by enclosing each list in parentheses; “(“, ”)”.

EXAMPLE 1 This example shows a list of items.

PARAMETER=item1,item2,item3,item4a%2Citem4b

This list consists of four values: item1, item2, item3 and the value “item4a,item4b”.

NOTE In this example, the embedded comma in the last item has been encoded as per IETF RFC 2396 in order to distinguish it from the commas used in the list of delimit list entries.

EXAMPLE 2 This example shows multiple lists of items assigned to a single parameter.

PARAMETER=(item11,item12,item13)(item21,item22,item23)

5.6 XML Schema fragments

This International Standard makes use of XML Schema (as given in W3C XML Schema Part 1 and W3C XML Schema Part 2) fragments to define the XML encoding of the components of a filter expression. These XML Schema fragments are collected into a set of consolidated schema files in Annex B.

6 Query expressions

6.1 General

A query expression (see Figure 2) is an action that performs a search over some set of resources and returns a subset of those resources. Other standards that reference this International Standard shall assert what a resource is.

EXAMPLE A WFS would assert that a resource is a feature.

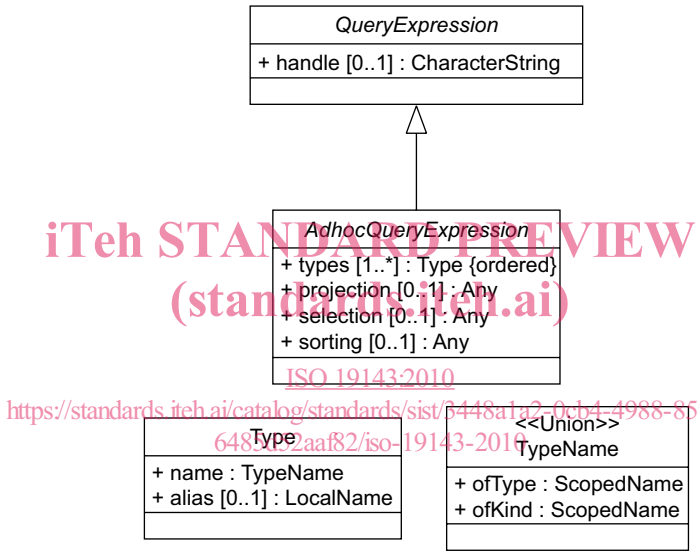

Figure 2 — Query expressions

6.2 Abstract query expressions

This International Standard defines the abstract element fes:AbstractQueryExpression as the head of a substitution group of query expressions. The element fes:AbstractQueryExpression is defined by the following XML Schema fragment:

```
<xsd:element name="AbstractQueryExpression"
             type="fes:AbstractQueryExpressionType" abstract="true"/>
<xsd:complexType name="AbstractQueryExpressionType" abstract="true">
   <xsd:attribute name="handle" type="xsd:string"/>
</xsd:complexType>
```

The fes:AbstractQueryExpression element defines the handle attribute which can be used to assign user-defined identifier to the query expression for the purpose of error handling or correlating the response to a query, from within a series of queries, with the source query expression.

International Standards that reference this International Standard shall declare the types(s) of resources that can be queried and shall derive query expressions from fes:AbstractQueryExpression.