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OpenGIS® OpenSearch Geospatial Extensions Draft Implementation Standard

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i. Preface

This document is the result of work undertaken within the GENESI-DR (Ground European Network for Earth Science Interoperations - Digital Repositories) project funded by the 7th Framework program of the European Commission in particular by Terradue SRL and collaborators.

ii. Document terms and definitions

This document uses the standard terms defined in Subclause 5.3 of [OGC 05-008], which is based on the ISO/IEC Directives, Part 2. Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

iii. Submitting organizations

The following organizations submitted this document to the Open Geospatial Consortium Inc.

Terradue SRL
FotiusOne

iv. Document contributor contact points

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v. Revision history

Date	Release	Editor	Primary clauses modified	Description
2009-06-01	0.0.1	Jo Walsh, Pedro Gonçalve, Andrew Turner	Initial Draft	Structure and notes, with description and extensions annexes in OGC Template
2009-10-10	0.0.1	Carl Reed	Various	Prepare for publication as an OGC DP

vi. Changes to the OGC Abstract Specification

The OpenGIS® Abstract Specification does not require changes to accommodate the technical contents of this document.

Foreword

The OpenSearch specification originates in a community effort built around Amazon's A9.com. It was intended to allow syndication of search results that could then be aggregated by one large index. The OpenSearch specification is made available under the Creative Commons Attribution-Sharealike 2.5 license. In addition, the OASIS Search Web Services group is publishing an Abstract Protocol Definition of the interface or "binding", which coincides with the community specification published at http://opensearch.org. In 2007, Andrew Turner proposed a set of geospatial extensions through OpenSearch.org.

This document codifies those extensions in a form compatible with OGC specifications, with one parameter (the spatial relation) added on the basis of feedback from developers in the open source geospatial community. This use of the OpenSearch Geospatial Extensions is intended to be complementary to the main Open Geospatial Consortium standard providing a machine-accessible search interface to a data repository, namely Catalogue Services for the Web [07-006r1] [insert OGC doc ref number here].

This document includes several annexes showing result sets in several possible formats and giving details that reflect a sample implementation.

This specification has been promoted and adopted in the context of the GENESI-DR project by several European Earth Science data centres. It was adopted within the project consortium as the minimal compliance level to develop discovery mechanisms in heterogeneous sites and to transform the repository network into a virtual distributed repository.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium Inc. shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

Introduction

This document is the specification for Geospatial Extensions to the OpenSearch protocol.

This specification is intended to provide a very simple way to make spatial queries to a repository of data with geographic properties, to allow simple syndication between repositories, and to provide a very basic “federation” of repositories, whereby a client can query several server instances and present a collection of results as one set.

The use cases at OpenSearch.org deal primarily with full-text search across textual data, but the protocol is equally applicable to simple searches across collections of structured data – particularly data with a geospatial component.

The specification is intended for re-use in quite heterogeneous environments – ranging from collections of media with a “neo-geography” flavour, through to large data processing sites involved in distributed repository networks, potentially worldwide. The specification has been applied within the GENESI-DR, (Ground European Network for Earth Science Interoperations - Digital Repositories), in which a network of partners, primarily engaged in processing of Earth Observation data, are using the OpenSearch Geospatial Extensions to syndicate results across sites and to provide a common interface to web-based search clients. This project, financed by the European Commission and lead by ESA, has the challenge of establishing open Earth Science Digital Repository access for European and worldwide science users. The purpose of the project is to develop and demonstrate a framework that allows users from different Earth Science disciplines to have access, to combine and to integrate Earth related data from space, airborne and in situ sensors held in Digital Repositories dispersed across Europe. Increased access to data is combined with access to processing resources.

The purposes defined for the use of this specification were defined in terms of top-level use cases for data and processing services discovery. In the case of the GENESI-DR project, its broad community is made up of Earth scientists and digital repositories of Earth Science data and processing resources. Any specific use of the infrastructure, however, involves one or more users, portal services and one or more Digital Repositories. In distributed, collaborative environments terms, GENESI-DR gives rise to Virtual Organisations which comprises a set of individuals and/or institutions having direct access to computers, software, data and other resources for collaborative problem-solving or other purposes. For the purpose of this specification the use case deals with scientific users needing input data to carry out their research and the need to simple ways to improve and expanding their discovery mechanisms to Earth Science data.

OpenGIS® Opensearch Geospatial Implementation Standard

1 Scope

This OGC discussion document specifies a set of geospatial extensions to the OpenSearch query protocol. OpenSearch is a collection of simple formats for the sharing of search results.

The OpenSearch description document format can be used to describe a search engine so that it can be used by search client applications.

The OpenSearch response elements can be used to extend existing syndication formats, such as RSS and Atom, with the extra metadata needed to return search results.

This use of the OpenSearch Geospatial Extensions is intended to be complementary to other metadata search solutions such as CSW and ebRIM, providing a “mass market” style interface to a shared repository.

2 Compliance

Compliance with this standard shall be checked using all the relevant tests specified in Annex A (normative).

3 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OASIS OpenSearch - *Search Web Services searchRetrieve Operation: Binding for OpenSearch Version 1.0* http://docs.oasis-open.org/search-ws/v1.0/opensearch-v1.0.html

OGC 05-008 - *OGC Web Services Common Specification*

OGC 06-121 - OWS Common Implementation Specification

OGC 07-147r2 - *OGC KML Specification*

RDF - *W3C RDF Specification Suite* - http://www.w3.org/RDF/

4 Terms and definitions

For the purposes of this standard, the definitions specified in Clause 4 of the OWS Common Implementation Specification [OGC 05-008] shall apply. In addition, the following terms and definitions apply.

4.1
OpenSearch
Draft specification for web search syndication, originating from Amazon's A9 project and given a corresponding interface binding by the OASIS Search Web Services working group.

4.2
OpenSearch Geospatial Service
Defines servers that comply with the OpenSearch Specification and the Geospatial extension defined in this document

4.3
OpenSearch Description Document
An XML document available at a consistent location describing metadata for the service and providing templates for queries.

5 Conventions

5.1 Abbreviated terms

Some of the abbreviated terms listed in Subclause 5.1 of the OWS Common Implementation Specification [OGC 06-121] apply to this document, plus the following abbreviated terms.

EC	European Commission
ESA	European Space Agency
EU	European Union
GENESI-DR	Ground European Network for Earth Science Interoperations – Digital Repositories
GeoJSON	Geospatial Extensions to JavaScript Object Notation
GeoRSS	Geospatial Extensions to Rich Site Syndication
INSPIRE	Infrastructure for Spatial Information in Europe
KML	Keyhole Markup Language
RDF	Resource Description Framework

REST	Representational State Transfer
SWS	Search Web Services
URL	Uniform Resource Locator
UUID	Universal Unique Identifier
WKT	Well Known Text

6 OpenSearch Geospatial Extensions overview

As the operation of the main OpenSearch specification is fully expressed in the OASIS SWS bindings, we confine ourselves here to the operations of the OpenSearch Geospatial extensions, offering a short overview of how they fit within the primary specification.

The basic concept of OpenSearch description is a simple format for specifying how to query a web resource, and additional metadata in the results to support syndicating these results. Search clients can use OpenSearch description documents to learn about the public interface of a search engine. These description documents contain parameterized URL templates that indicate how the search client should make search requests. Search engines can use the OpenSearch response elements to add search metadata to results in a variety of content formats. For example, if a web site allows search by the URL:

http://www.example.com?q=question

OpenSearch provides a way to define where that search term goes. Essentially it would look like: http:// www.example.com?q={searchTerms}, where {searchTerms} would be replaced by any general string. Using OpenSearch, aggregators and applications have a way to simply define a search service and let a user just type in their terms, but then search N search engines. For example, the Firefox search bar is powered by OpenSearch and allows the user to add new OpenSearch compliant site.

The Description provides some basic metadata about the contents of the service and the contact information pertaining to it, along with a set of URL Templates which illustrate the parameters accepted by the service and the variety of output formats in which results can be obtained. The OpenSearch request interface is simple, consisting of a description of a HTTP GET request with a series of optional key-value parameters that can be used to constrain the search.

The Geospatial Extensions specify a series of parameters that can be used to geographically constrain search results. These are discussed in more detail in Section 9. In short, provision is made to filter results by:

a) A bounding box

b) An arbitrary polygon, using Well Known Text to define the geometry

c) Within a certain radius from a given latitude-longitude point

d) Having a certain containment relation (within, overlaps, disjoint) with a geographic constraint

e) Matching a geographic name (not considered in our use cases, but forming part of the original specification)

f) Matching a given unique identifier in the context of the repository

All geographic information is given to be expressed using the EPSG 4326 (WGS84) coordinate reference system, and any output listing the extents of the original query or containing further geographic information about the search results, will similarly be expressed in EPSG 4326. There is precedent for this in related OGC “Mass Market” standards, specifically GeoRSS.

A sample of a Description showing the use of Geospatial Extensions with several output formats appropriate for geographic search results can be seen in Annex D.

7 Shared aspect

Not applicable

8 OpenSearch Description (mandatory)

8.1 Introduction

The OpenSearch Description Document allows clients to retrieve service metadata from a server. The response to a request for a Description shall be an XML document in the form specified by the SWS OpenSearch bindings published by OASIS. A brief summary of the Description's requirements is offered here.

The service metadata covered by the OpenSearch Description corresponds to the service metadata returned by e.g. a WMS GetCapabilities request. The request is not parameterised, but simply takes the form of an HTTP GET request to a URL (advertised on a web page or obtained from a repository of OpenSearch services which offer syndication of their result sets).

The Description document contains information on the maintainer of the service and their contact information. It includes a brief title and short abstract describing the contents of the service, along with a list of keywords and optionally a list of languages in which the contents may be returned.

The key feature of the Description document is the URL template, which instructs a client application how to issue queries to the service. The URL template represents a parameterized form of the URL by which a search engine is queried. Each response

format supported by the service needs its own distinct URL template included in the Description. A service can extend the basic parameters included in the template.

EXAMPLE 1 The following XML document provides a sample response to a request for an OpenSearch Description from a repository supporting the Geospatial Extensions.

```
<?xml version="1.0" encoding="UTF-8"?>
<OpenSearchDescription xmlns="http://a9.com/-/spec/opensearch/1.1/"
xmlns:geo="http://a9.com/-/opensearch/extensions/geo/1.0/">
<ShortName>Web Search</ShortName>
<Description>Use Example.com to search the Web.</Description>
<Tags>example web</Tags>
<Contact>admin@example.com</Contact>
<Url type="application/vnd.google-earth.kml+xml"
template="http://example.com/?q={searchTerms}&pw={startPage?}&bbox={geo
:box?}&format=kml"/>
<Url type="application/rdf+xml"
template="http://example.com/?q={searchTerms}&pw={startPage?}&bbox={geo
:box?}&format=rdf”/>
<Url type="application/geojson"
template="http://example.com/?q={searchTerms}&pw={startPage?}&bbox={geo
:box?}&format=geojson"/>
<Url type="text/html"
template="http://example.com/?q={searchTerms}&bbox={geo:box?}&pw={start
Page?}"/>
<LongName>Example.com Web Search</LongName>
<Query role="example" searchTerms="cat" geo:box=”10,10,12,12”/>
<Attribution>
Search data Copyright 2005, Example.com, Inc., All Rights Reserved
</Attribution>
<SyndicationRight>open</SyndicationRight>
</OpenSearchDescription>
```

For detail on the required and optional fields, please refer to the OASIS SWS bindings for OpenSearch [OASIS OpenSearch].

9 OpenSearch Geospatial Extensions operation (mandatory)

9.1 Introduction

OpenSearch Geospatial Extensions are designed to provide a basic geographic search facility to the OpenSearch protocol. A namespace is provided for use in URL templates that form part of the OpenSearch Description Document (see Annex D for an example), published by the server in XML at a stable URL.

OpenSearch has a lot more functionality and is especially useful when requesting syndication formats such as Atom or RSS. With the OpenSearch geospatial extension to it is possible to formulate requests to all records found within a spatial area defined as a point-plus-radius, a bounding box, or a polygon. Together with the Time extension, OpenSearch can specify time start, finish, and slices for searching data.

The flexibility of the OpenSearch protocol allows one to return lists of search results in any format that a client can be persuaded to understand. While Atom is common, search

results in KML, JSON or GeoJSON are equally possible. A server provides a description document that a client reads to determine how to formulate a search/retrieve request and interpret the response. The client may send a request, including search terms, to the server, who replies with a response that includes results based on the search terms.

The OpenSearch Description Document includes a mandatory URL element containing a mandatory request template. Where several request templates are provided, a client may choose the one offering the most useful format (specified by MIME type). The following XML snippet illustrates a URL template suggesting a bounding box query for data, with results returned in KML.

```
<Url type="application/vnd.google-earth.kml+xml"
template="http://example.com/?q={searchTerms}&pw={startPage?}&bbox={geo
:box?}&format=kml"/>
```

The current XML namespace of the OpenSearch Geo Extension is:

```
http://a9.com/-/opensearch/extensions/geo/1.0/
```

This namespace and a corresponding namespace prefix must be included when the extension is used in an OpenSearch Description document.

9.2 Search operation request

9.2.1 Search request parameters

The following parameters can be submitted as part of a search request.

Table 1 — Parameters in a Search operation request

Names [a]	Definition	Data type and values	Multiplicity and use
box	Geographic bounding box	The box is defined by "west, south, east, north" coordinates of longitude, latitude, in a EPSG:4326 decimal degrees	One (optional)
geometry	Geographic area (geometry)	The geometry is defined using the Well Known Text standard for geographic shapes, using EPSG:4326.	One (optional)
uid	Unique identifier of the record in the repository context	Character String	One (optional)
lat	The latitude of a given point	Latitude in decimal degrees in EPSG:4326	One (optional)
lon	The longitude of a given point	Longitude in decimal degrees in EPSG:4326	One (optional)
radius	A search radius from a lat-lon point	The distance in meters along the Earth's surface.	One (optional)
relation	Spatial relation to result set	Character String; One of “overlaps”, “contains”, “disjoint” (default is “overlaps”)	One (optional)
name	A string describing the location to perform the search.	Character String	One (optional)

a The name capitalization rules being used here are specified in Subclause 11.6.2 of [OGC 05-008].

Note that for the given key-value pairs, the key can be an arbitrary string, specified by one given instance of an OpenSearch repository. For example, one Description may provide a URL template asking for box={geo:box}, another specifying bbox={geo:box}. It is the responsibility of the client application to parse the URL template and create the appropriate keys for each key-value pair. These parameter sets are templates from which URLs can be constructed. The search client must replace every instance of a template parameter with a value before the search request is performed. If a search engine wishes to indicate that a template parameter is optional and can be replaced with the empty string, then the "?" notation described in the section on optional template parameters should be used.

All the “optional” parameters and data structures in the Search operation request should be implemented by all Search clients using specified values for each implemented Search to which that parameter or data structure applies. Similarly, all the “optional” parameters and data structures shall be implemented by all OpenSearch GeoSpatial Servers, for each implemented Search to which that parameter or data structure applies.

9.2.2 Search request KVP encoding (mandatory)

Servers may implement HTTP GET transfer of the Search operation request, using KVP encoding. The KVP encoding of the Search operation request shall use the parameters specified in Table 2. The parameters listed in Table 2 shall be as specified in Table 1 above.

Table 2 — Search operation request URL parameters

Name and example [a]	Optionality and use	Definition and format
bbox={geo:box}	Optional	Rectangular bounding box
geom={geo:geometry}	Optional	Geometry in WKT
id={geo:uid}	Optional	Unique identifier of the record in the repository context
lat={geo:lat}&lon={geo:lon} & radius={geo:radius}	Optional	Centroid (latitude and longitude) and a search radius
rel={geo:relation}	Optional	Relation. The default is overlap
loc={geo:name}	Optional	Character string with a geographical name to be geocoded

a All parameter names are here listed using mostly lower case letters. However, any parameter name capitalization shall be allowed in KVP encoding, see Subclause 11.5.2 of [OGC 05-008].

EXAMPLE An example Search operation request KVP encoded for HTTP GET is:

```
http://foo.bar/foo?q=coverage&bbox=120,10,134,14
```

9.3 Search operation response

9.3.1 Normal response parameters

The normal response to a valid Search operation request shall be in one of several formats that are specified in the OpenSearch Description for a given instance. Preferred formats for results include XML, KML, and GeoJSON. A response from the Search operation shall include the parts listed in in Table 3 for each item in the set of results. The metadata for each item in the result set shall contain a link to a “full” view of the result, where more detailed metadata can be provided.

Table 3 — Parts of Search operation response

Names	Definition	Data type and values	Multiplicity and use
Link	A reference to a location where full metadata for the resource is available	HTTP URL	1 (Mandatory)
Title	Title of the resource	Character String	1 (mandatory)
Abstract	Short description of the resource	Character String	1 (optional)
Geometry	Geographical area containing the resource	WKT string expressing the geometry of the resource	1 (optional)
a			

9.3.2 Normal response XML encoding

The XML fragments shown in Appendix D specify the contents and structure of a Search operation response. In addition to the XML encodings shown, provision is made to encode search results using the Javascript Object Notation with geospatial extensions, or GeoJSON.

The normative response format for an OpenSearch service using Geospatial Extensions should be in KML 2.2 (or future versions). The properties shown in the OpenSearch namespace are those mandated by the core specification.

9.3.3 KML response example

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.2"
xmlns:atom="http://www.w3.org/2005/Atom"
xmlns:opensearch="http://a9.com/-/spec/opensearch/1.1/"
xmlns:opensearchgeo="http://a9.com/-/opensearch/extensions/geo/1.0/">

<opensearch:totalResults>4230000</opensearch:totalResults>
<opensearch:startIndex>21</opensearch:startIndex>
<opensearch:itemsPerPage>10</opensearch:itemsPerPage>
<opensearch:itemsPerPage>10</opensearch:itemsPerPage>
<opensearch:Query role="request" searchTerms="New York History"
startPage="3" geo:box="-74.0667,40.69418,-73.9116,40.7722"/>

<atom:link rel="alternate"
href="http://example.com/New+York+History?pw=3&bbox=-74.0667,40.69418,-
73.9116,40.7722" type="text/html"/>

<atom:link rel="alternate"
href="http://example.com/New+York+History?pw=3&bbox=-74.0667,40.69418,-
73.9116,40.7722&format=atom" type="application/atom+xml"/>
<Document>
    <name>NYCHistory.kml</name>
    <open>1</open>
    <Placemark>
    <name>New York History</name>
```

```
    <atom:link>http://www.columbia.edu/cu/lweb/eguids/amerihist/nyc.html
    </atom:link>
<LineString>
<coordinates>
-73.9972,40.73763,0 -73.99167,40.73519,0 -73.99035,40.737015,0
-73.98914,40.73643,0 -73.990431,40.734640,0 -73.991504,40.731617,0
</coordinates>
</LineString>
</Placemark>
</Document>
</kml>
```


Annex A
(normative)

Abstract test suite

An abstract test suite is not provided in this version of this Implementation Standard, but will be provided in version 1.0.0.

Annex B
(normative)

XML Schema Documents

Annex C
(informative)

UML model

Annex D
(informative)

Example XML documents

D.1 Introduction

To share information about data sets and series available on Digital Repository nodes, the GENESI-DR project defines a RDF model rendered in XML. Participating organisations publish RDF/XML files describing updates to their data products. The following is an informative example of such a RDF/XML.

D.2 RDF/XML Output

```
<?xml version="1.0" encoding="utf-8"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dct="http://purl.org/dc/terms/"
xmlns:dclite4g="http://xmlns.com/2008/dclite4g#"
xmlns:ical="http://www.w3.org/2002/12/cal/ical#"
xmlns:os="http://a9.com/-/spec/opensearch/1.1/">

<rdf:Description rdf:about="http_link_to_this_request">
<os:totalResults>4230000</os:totalResults>
<os:startIndex>21</os:startIndex>
<os:itemsPerPage>1</os:itemsPerPage>
</rdf:Description>
<dclite4g:Series rdf:about="http://dr-
site.esrin.esa.int/genesi/envisat_meris/mer_rr__2p/description/">
<dc:identifier>MER_RR__2P</dc:identifier>
<dc:description
rdf:resource="http://earth.esa.int/dataproducts/MER_RR__2P"/>
<dc:title>
MERIS Reduced Resolution Geophysical Product (MER_RR__2P)
</dc:title>
<dc:abstract>
The MEdium Resolution Imaging Spectrometer Instrument (MERIS) is a 68.5
degree field-of-view push-broom imaging spectrometer that measures the
solar radiation reflected by the Earth, at a ground spatial resolution
of 300 m, in 15 spectral bands, programmable in width and position, in
the visible and near infrared wavelengths. MERIS allows global coverage
of the Earth in 3 days. The primary mission of MERIS is the measurement
of sea colour in the oceans and in coastal areas. Knowledge of sea
colour can be converted into a measurement of chlorophyll pigment
concentration, suspended sediment concentration and of atmospheric
aerosol loads over water. The instrument always takes measurements with
full resolution; i.e., 260 m x 290 m ground resolution. Onboard
averaging generates the Reduced Resolution (RR) images. The MERIS Level
2 are water leaving radiance (reflectance) and geophysical product
generated systematically from MERIS L1B. It has a coverage of 1150 km x
```


17500 km and a radiometric resolution of 1.42 X 10-4 at sea level at 442.5nm. The accuracy is as follows: Surface reflectance (ocean) < 2 x 10E-4; Surface reflectance (Land) < 5%; Chlorophyll retrieval < 15 %; Yellow substance < 30 %; Suspended matter < 15 %; Water vapour < 20%; Cloud albedo < 2 %; Cloud optical thickness ~ 10%; Cloud top pressure ~ 40 hPa; MERIS Vegetation Index:-N/A. The file size is 621 Mbytes per orbit and 47 Mbytes per scene. Auxiliary data include: Surface identification flags included in the level 1b product Orbit state vector, Time correlation parameters, Latitude, Longitude, altitude and topographic corrections Sun azimuth, Sun elevation, view azimuth, view elevation, Mean Sea Level pressure, Total column ozone, Total column water vapour, Wind speed
</dc:abstract>
<dc:subject>
Atmosphere (Air Quality, Ozone, Clouds), Land (Vegetation), Water (Water Temperature), suspended sediment concentration
</dc:subject>
<dc:contact>http://eohelp.esa.int/</dc:contact>
<dc:rights>Free Usage with Rigths</dc:rights>
<dct:spatial>
POLYGON((-180 -90,-180 90,180 90,180 -90,-180 -90))
</dct:spatial>
<dclite4g:projection>pseudo-satellite projection along track</dclite4g:projection>
<dc:format>ENVISAT Standard</dc:format>
<dclite4g:resolution>1200</dclite4g:resolution>
</dclite4g:Series>
</rdf:RDF>

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