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WCS 2.0 Overview: Core and Extensions

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Editorial note: revision numbers for the references to documents of the WCS 2.0 set are not yet adjusted; this will be done in the final editing step.

Warning

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i. Preface

This document provides an overview on the OGC Web Coverage Service (WCS) 2.0 suite by describing WCS core and extensions.

Intended target audience are developers intending to implement WCS servers and/or clients. This document aims at providing an overview and giving useful hints and best practices beyond the pure standards texts.

As such, the contents of this document is informative and not of normative nature.

ii. Terms and definitions

This document uses the specification terms defined in Subclause 5.3 of [OGC 06-121r3], 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 have submitted this Implementation Specification to the Open GeoSpatial Consortium, Inc.:

- Jacobs University Bremen
- rasdaman GmbH
- National Center for Atmospheric Research (NCAR)
- Oracle USA
- PCI Geomatics Inc.
- ERDAS, Inc.
- EOX IT Services GmbH
- Spot Image
- BAE Systems - C3I Systems
- Natural Environment Research Council (NERC)
- George Mason University

iv. Document Contributor Contact Points

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v. Revision history

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vi. Changes to the OpenGIS[®] Abstract Specification

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

vii. Future Work

This document needs to be updated whenever a new extension is added to WCS. It may need an update if and when significant functionality changes are made to existing WCS components.

Foreword

Some of the elements of this document may be the subject of patent rights. Open GeoSpatial Consortium Inc. shall not be held responsible for identifying any such patent rights.

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Introduction

The OGC Web Coverage Service (WCS) supports electronic retrieval of geospatial data as "coverages" – that is, digital geospatial information representing space/time-varying phenomena.

WCS 2.0 consists of a set of normative specifications, collectively referred to as “the WCS suite”. These specifications encompass:

- GML 3.2 Application Schema for WCS [OGC 09-146]
- WCS 2.0 Core [OGC 09-110]
- A set of extensions to the WCS Core.

This document provides an overview on the OGC Web Coverage Service (WCS) 2.0 suite by describing WCS core and extensions. As such, the contents of this document is informative and not of normative nature.

WCS 2.0 Overview: Core and Extensions

1 Scope

Scope of this document is the OGC Web Coverage Service (WCS) set of standards.

2 Compliance

This Best Practice document does not contain any normative statements, hence no compliance is defined. In case there are any deviations between the standards mentioned and this document the standards texts shall prevail.

3 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this specification. 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.

ISO 19111:2003, *Geographic Information – Spatial referencing by coordinates*. ISO, 2003

ISO 19123:2005, *Geographic Information — Coverage Geometry and Functions*. ISO, 2005

OGC 04-46r3, *Abstract Specification Topic 2: Spatial referencing by coordinates*, version 3.0

OGC 06-121r8, *OGC Web Services Common Specification*, version 1.2

OGC 07-011, *Abstract Specification Topic 6: The Coverage Type and its Subtypes*, version 7.0

OGC 07-036, *Geography Markup Language (GML) Encoding Standard*, version 3.2.1

OGC 09-110, *WCS 2.0 Core Interface Standard*, version 2.0.0

OGC 09-146, *GML 3.2 Application Schema for WCS*, version 1.0.0

In addition to this document, the WCS specifications include normative XML Schema files. These are posted online at <http://schemas.opengis.net/wcs/2.0> as part of the OGC schema repository. The documents, bundled with these XML Schema files, are available on <http://www.opengeospatial.net/standards/wcs>.

4 Terms and definitions

None defined here; definitions from GML Application Schema [OGC 09-146] and WCS Core [OGC 09-110] apply.

5 Conventions

5.1 UML notation

All the diagrams that appear in this specification are presented using the Unified Modeling Language (UML) static structure diagram, as described in Subclause 5.2 of OGC Web Services Common [OGC 06-121r3].

5.2 Namespace prefix conventions

None defined here; definitions from GML Application Schema [OGC 09-146] and WCS Core [OGC 09-110] apply.

6 WCS Package Overview

6.1 Core and extensions

Based on the WCS model defined in this document and a WCS core specification, many extension packages are conceivable which add specific functionality to the WCS data and/or service model.

The list presented below contains existing, planned, and possible WCS extensions. It makes use of a grouping which appears reasonable at the time of this writing; however, this structuring is by no means normative and shall not be used to draw any conclusions on the functionality a particular specification provides.

For an illustration, some possible extensions are listed in Section 7.

WCS Core and each extension specify, as normative requirements, which prerequisite specifications they require. Frequently, options are possible in some specific group of extensions; for example, every WCS implementation must support at least one protocol extension.

This constitutes a dependency graph as shown in Figure 1.

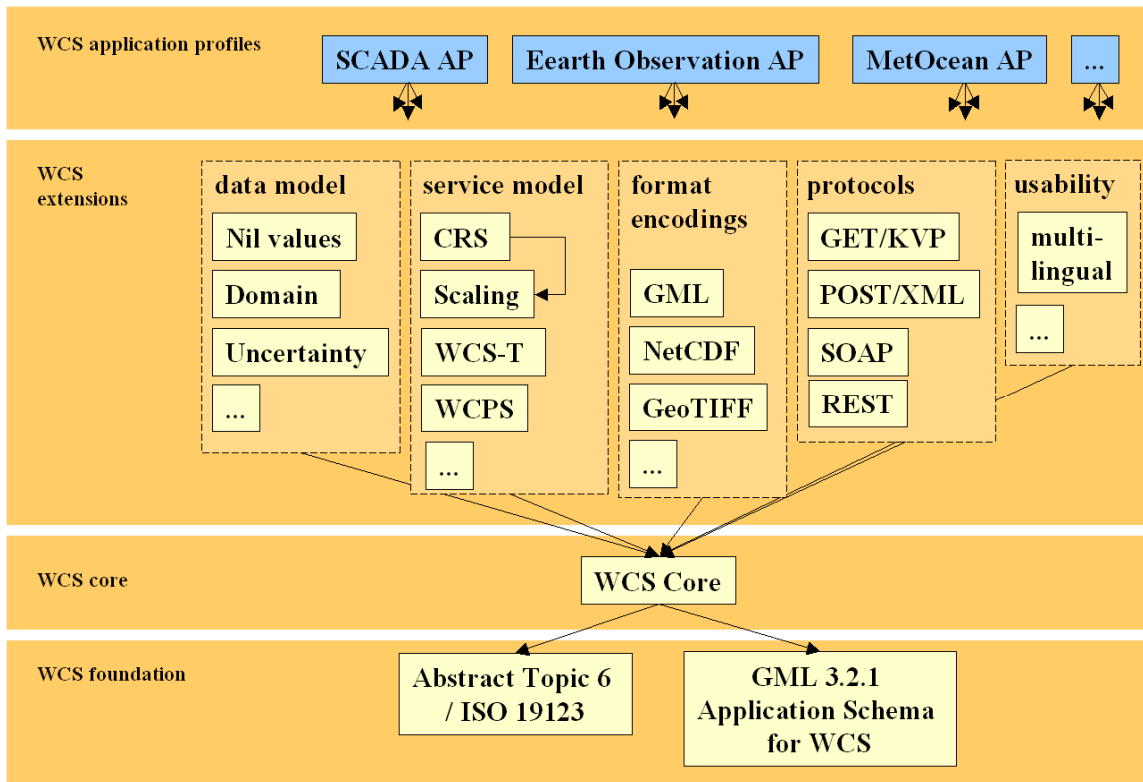


Figure 1 —WCS specification hierarchy graphical overview

6.2 Application Profiles

An Application Profile (AP) trims WCS functionality for some particular purpose. To this end, two mechanisms are available:

- The AP can make a choice among the extensions it declares mandatory (note that the core has to be included in any case).

Note that there are cross dependencies among some extensions which have to be respected. For example, the core requires at least one protocol extension, and the CRS extension requires the scaling & interpolation extension.

For example, a SCADA (Supervisory Control and Data Acquisition) AP might allow only 1-D time coverages and GML encoding, whereas an Earth Observation AP might allow only x/y and x/y/t coverages and GeoTIFF, but not include a GML encoding.

- Additional restrictions can be imposed on core and extensions.

In the above example, the Earth Observation AP might allow only x/y and x/y/t coverages and GeoTIFF, but no GML encoding.

Consequently, a conformance test for an AP will in turn inspect the GML Application Schema for WCS, the WCS Core, any extension listed, and finally the specific requirements of the AP on hand.

7 Possible extensions

In this section, some WCS extensions are listed which appear meaningful to the WCS Working Group at the time of creating WCS 2.0. Some of them are already available as adopted specifications, some of them not. By no means is this list indicative or comprehensive; some extensions listed here may never be written, and others not listed may be developed.

Following the presentation in Section 6, extensions are grouped into

- Data model extensions: they extend or refine coverage-related data structures;
- Service model extensions: they add further service capabilities;
- Format encoding extensions: they describe encodings applicable for the transfer of coverages (not request encodings);
- Protocol extensions: they describe client/server communication protocols and the encoding of parameters shipped using these protocols.
- Usability extensions: they add means to better use the services.

7.1 Data model extensions

7.1.1 Purpose

This category of extensions focuses on adding information contents to the coverage model, be it for coverages when offered by a WCS server or for coverages generated for delivery or consumption by a WCS.

7.1.2 Identification

Every WCS extension is identified by a unique URN which, by convention, is specified in the first formal requirement of an extension specification.

All extensions implemented by a WCS server must be reported by that server; this is done by listing the identifying URN of each extension in the `Profile` list of its *GetCapabilities* response.

WCS extension identifiers follow this schema:

```
urn:ogc:def:extension:OGC-WCS:COREV:CLASS:EXT:EXTV
```

where

COREV is a string consisting of a number followed by a dot followed by a number; this string represents the version number of the WCS Core to which this extension pertains.

CLASS is a non-empty string consisting of alphanumeric and underscore characters; this string represents the class to which this extension pertains, which is unambiguous within WCS.

EXT is a string consisting of a number followed by a dot followed by a number; this string represents the name of this extension, which is unambiguous within its class.

EXTV is a string consisting of a number followed by a dot followed by a number; this string represents the version number of this extension.

7.1.3 List of extensions

7.1.3.1 Null values

Specific values can be designated to represent “nil” / “null” values. This extension is expected to be written soon. The GML 3.2 Application Schema for WCS [OGC 09-146] is already prepared for holding null values.

7.1.3.2 Domain-related extensions

The variability of WCS allows coverages of any number of dimensions. As WCS implementations are foreseen which focus on particular application domains and use cases where implementing this full generality is not desirable, useful special cases have been defined in bespoke extensions.

- Time series

Coverages are one-dimensional and have only a time dimension. Often this dimension is named “t” or “time”.

- Map imagery

Coverages are two-dimensional and have only geographically horizontal dimensions. Often these dimensions are named “x” and “y” or “latitude and longitude”.

- General spatio-temporal data

Coverages are one- to four-dimensional; often their dimension names are “x”, “y”, “z”, and “t”.

- General n-dimensional data

The domain of a coverage can have $n > 0$ spatial, temporal, or “abstract” (i.e., non-spatio-temporal) domain axes. Dimension names are application dependent, but must not conflict nor be confusable with the names of spatio-temporal dimensions.

7.1.3.3 Complex range types

Such an extension would allow further range structures, beyond the “flat” atomic range fields currently supported by WCS 2.0. However, this would also require an update of the GML 3.2 Application Schema for WCS [OGC 09-146] and, hence, needs to be done in collaboration with the GML Working Group. This may happen in the course of jointly reconsidering the coverage model of GML 3.3 / 4.0.

7.1.3.4 Coverage hierarchies

Coverages can be grouped hierarchically, GetCoverage requests can be performed on such groupings.

NOTE Currently, no consistent semantics of such hierarchical coverages is known.

7.1.3.5 Uncertainty

Coverage range values can be annotated with a degree of uncertainty. This extension is under discussion, however, it is felt that an OGC-wide overarching concept should be resolved first rather, than establishing an ad-hoc solution.

7.2 Service model extensions

This category of extensions describes additional functionality which may be added to a WCS.

7.2.1 List of extensions

7.2.1.1 Scaling and interpolation

With this extension, GetCoverage allows for scaling of coverage results; different interpolation techniques can be selected for the resampling performed during a scaling operation.

7.2.1.2 CRS transformation

This will allow coverages to be requested in different CRSs; the server needs to be able to perform a CRS transform of the coverage prior to its delivery. This extension requires extension “Scaling and interpolation”.

NOTE This will be a normative requirement stated in the WCS 2.0 CRS Extension (which is not yet existing, but in planning at the time of this writing).

The variability and complexity of CRS handling suggests that special cases are defined in bespoke extensions:

- Use if predefined CRSs only

CRSs are indicated through EPSG codes.

- Ad-hoc definition of CRSs

At any position where a CRS parameter occurs in WCS, CRSs can be defined locally (including nested transformations).

scaling of coverage results; different interpolation techniques can be selected for the resampling performed during a scaling operation.

7.2.1.3 Transactional service (WCS-T)

WCS-T [OGC 07-068r4] allows to insert, update, and delete coverages offered by a WCS server.

7.2.1.4 Web Coverage Processing Service (WCPS)

WCPS defines a query language which allows to combine and process coverages for navigation, extraction (download), aggregation, and ad-hoc analysis. The abstract language is defined in [OGC 08-068r1], the WCS protocol embedding in [OGC 08-059r3]. The WCS embedding of WCPS requires implementation of [OGC 08-068r1].

7.3 Protocol extensions

7.3.1 Purpose

This category of extensions describes client / server communication protocols (including request parameter encodings) which a WCS implementation may offer and use. Every WCS, be it client or server, shall support at least one protocol extension.

NOTE This does not include result coverage encodings as delivered by GetCoverage requests.

7.3.2 List of extensions

7.3.2.1 HTTP GET/KVP

Requests are sent as HTTP GET parameters. Coverages are encoded in some data format (as specified by a format encoding extension), other response parameters are encoded in XML.

7.3.2.2 HTTP POST/XML

Requests are sent as HTTP POST using an XML encoding. Coverages are transferred using some data format (as specified by a format encoding extension).

7.3.2.3 SOAP

Requests and responses are communicated via SOAP using XML. Coverages are transferred using some data format (as specified by a format encoding extension).

7.3.2.4 REST

Requests are sent using the RESTful paradigm. Coverages are encoded in some data format (as specified by a format encoding extension).

7.4 Coverage encoding extensions

7.4.1 Purpose

Coverages can be delivered by GetCoverage requests (or uploaded, via WCS-T Transaction requests) in different data formats.

In addition and independently from any data format, coverages can be delivered as either pure GML documents, or as a format-encoded data file only, or as a combination where GML is used to represent the metadata and the data file holds the range values (“pixels”, “voxels”). This will be described in a separate format extension.

Every WCS, be it client or server, shall support at least one encoding format. This can be a format defined in an extension or the GML coverage representation defined in [OGC 09-110] and [OGC 09-146].

7.4.2 List of extensions

This open-ended list is likely to encompass GML, NetCDF, GeoTIFF, and many more.

Note that not all formats are suitable to transport all kinds of coverages; limitations can be given by, for example, the dimensions supported (TIFF cannot hold 4-D coverages) or the cell type (BMP cannot hold hyperspectral imagery).

7.5 Usability extensions

7.5.1 Purpose

This set of extensions focuses on usability of the service overall, rather than on bespoke data or service functionality.

7.5.2 List of extensions

7.5.2.1 Multi-lingual support

Text messages can be delivered in various languages by a service.