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OGC[®] OWS-8 WCS 2.0 Earth Observation Application Profile Engineering Report

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This document is a deliverable for the OGC Web Services 8 (OWS-8) testbed activity. OWS testbeds are part of OGC's Interoperability Program, a global, hands-on and collaborative prototyping program designed to rapidly develop, test and deliver proven candidate standards or revisions to existing standards into OGC's Standards Program, where they are formalized for public release. In OGC's Interoperability Initiatives, international teams of technology providers work together to solve specific geoprocessing interoperability problems posed by the Initiative's sponsoring organizations. OGC Interoperability Initiatives include test beds, pilot projects, interoperability experiments and interoperability support services - all designed to encourage rapid development, testing, validation and adoption of OGC standards.

The OWS-8 sponsors are organizations seeking open standards for their interoperability requirements. After analyzing their requirements, the OGC Interoperability Team recommend to the sponsors that the content of the OWS-8 initiative be organized around the following threads:

- * Observation Fusion
- * Geosynchronization (Gsync)
- * Cross-Community Interoperability (CCI)
- * Aviation

More information about the OWS-8 testbed can be found at:

<http://www.opengeospatial.org/standards/requests/74>

OGC Document [11-139] “OWS-8 Summary Report” provides a summary of the OWS-8 testbed and is available for download:

https://portal.opengeospatial.org/files/?artifact_id=46176

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OGC® OWS-8 WCS 2.0 Earth Observation Application Profile Engineering Report

1 Introduction

1.1 Document contributor contact points

All questions regarding this document should be directed to the editors:

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2 References

The following documents are referenced in 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.

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

OGC 10-110r3, *OGC® Web Coverage Service 2.0 Interface Standard Core*, version 2.0.0

OGC 10-146r1, *OGC® GML 3.2.1 Application Schema for Coverages*, version 1.0.0

OGC 11-140, *OGC® Web Coverage Service 2.0 Interface Standard – Earth Observation Application Profile*, version 1.0.0

OGC 11-045, *GMLCOV change request – Additional Coverage Encodings*

OGC 11-050, *WCS 2.0 Core change request – Coverage Encoding Parameters*

3 EO-WCS

The *OGC® Web Coverage Service 2.0 Interface Standard - Earth Observation Application Profile* (EO-WCS) defines a profile of WCS 2.0 [OGC 09-110r3] for use on Earth Observation data. An Application Profile bundles several specifications and possibly adds additional requirements on an implementation. Extra requirements can be additions (for example, Dataset Series and Stitched Mosaics are introduced by this specification) or constraints (for example, coverages offered are restricted to 2-D rasters).

This Engineering Report describes progress on EO-WCS in the course of OWS-8.

4 Specification changes

The WCS.SWG currently discusses a corrigendum version 2.0.1 to WCS 2.0. Some of the corrigenda are needed for EO-WCS.

In particular the addition of an `<any>` element to the `<Contents>` element of the GetCapabilities response as shown below is needed to report `<DatasetSeriesSummary>` elements:

```
<any minOccurs="0" maxOccurs="unbounded" processContents="lax" namespace="##other"/>
```

The full definition of the `<Contents>` element reads as follows:

```
<element name="Contents" type="wcs:ContentsType">
  <annotation>
    <documentation>This element redefines the OWS Common [OGC 06-121r9] Contents
    section with a CoverageSummary, in accordance with the rules for modification laid down
    there. In addition it allows WCS extensions or application profiles to extend its
    content.</documentation>
  </annotation>
</element>
<complexType name="ContentsType">
  <complexContent>
    <extension base="ows:ContentsBaseType">
      <sequence>
        <element ref="wcs:CoverageSummary" minOccurs="0" maxOccurs="unbounded"/>
        <any minOccurs="0" maxOccurs="unbounded" processContents="lax"
namespace="##other"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

Below an example of a XML instance is given:

```
<wcs:Contents>
  <wcs:CoverageSummary>
    <wcs:CoverageId>someEOCoverage1</wcs:CoverageId>
    <wcs:CoverageSubtype>RectifiedDataset</wcs:CoverageSubtype>
  </wcs:CoverageSummary>
  <wcseo:DatasetSeriesSummary>
    <ows:WGS84BoundingBox>
      <ows:LowerCorner>-180 -90</ows:LowerCorner>
      <ows:UpperCorner>180 90</ows:UpperCorner>
    </ows:WGS84BoundingBox>
  </wcseo:DatasetSeriesSummary>
</wcs:Contents>
```

```

<wcseo:DatasetSeriesId>someDatasetSeries</wcseo:DatasetSeriesId>
<gml:TimePeriod gml:id="someDatasetSeries_timeperiod">
  <gml:beginPosition>2010-01-01T00:00:00.000</gml:beginPosition>
  <gml:endPosition>2010-12-31T23:59:59.999</gml:endPosition>
</gml:TimePeriod>
</wcseo:DatasetSeriesSummary>
</wcs:Contents>

```

5 Adoption progress

The specification document OGC 11-140 was reviewed by the OAB and the public RFC period was announced on July 21st 2011 and closed on August 20th 2011 without any comment submitted via the official means. Only some comments sent via e-mail on June 17th 2011 will be considered by the WCS.SWG for the version released for voting and IPR period. The goal of the authors is to have the final version ready for SWG voting at the Boulder TC in September 2011.

6 Implementation progress

The EO-WCS specification is known to be currently implemented by at least two Open Source software tools namely EOxServer and GMU Earth Observation WCS v2.0.

6.1 EOxServer

EOxServer (<http://eoxserver.org>) is a server for Earth Observation (EO) data. EOxServer implements the OGC Implementation Specifications EO-WCS and EO-WMS on top of MapServer's¹ WCS and WMS implementations.

EOxServer is released under the EOxServer Open License a MIT-style license and is written in Python² and entirely based on Open Source software including MapServer, Django³, GDAL⁴, Spatialite⁵, or PostGIS⁶, and PROJ.4⁷. Prior versions up to 0.1.x are released under the GNU General Public License.

The currently available functionality includes:

- ☐ Support of GML AP – Coverages for RectifiedGridCoverages
- ☐ Support of adopted WCS 2.0 specification (Core including GetCapabilities, DescribeCoverage, and GetCoverage requests, KVP-, and XML/POST protocol binding)

¹ URL: <http://www.mapserver.org/>

² URL: <http://www.python.org/>

³ URL: <http://www.djangoproject.com/>

⁴ URL: <http://www.gdal.org/>

⁵ URL: <http://www.gaia-gis.it/spatialite/>

⁶ URL: <http://postgis.refrains.net/>

⁷ URL: <http://trac.osgeo.org/proj/>

- Anticipated support of envisaged extensions: Coverage format, GeoTIFF encoding, predefined (or EPSG) CRSs, scaling & interpolation, and non-referenced access. By "anticipating" we mean to reflect the latest WCS.SWG discussions as well as to apply the relevant parts of the previous 1.1 and 1.0 versions of WCS.
- Support of 2-D EO Coverages derived from gmlcov:RectifiedGridCoverage
- Support of Dataset Series as a collection of EO Coverages e.g. in a time series
- Support of new DescribeEOCoverageSet operation on Dataset Series and EO Coverages
- Support of Stitched Mosaic of Rectified EO Coverages including concept of contributingFootprint
- Support of EO Metadata (retrieval and evaluation in DescribeEOCoverageSet operation)
- Protocoll bindings supported:
 - KVP
 - XML/POST (used together with SOAP2POST Proxy to support XML/SOAP protocol binding)
- Coverage formats supported:
 - GeoTIFF
 - Formats supported by the GDAL library (support needs to be verified for each required format separately)
- Support of EO-WMS for EO Coverages

EOxServer packages can be downloaded from <http://eoxserver.org/wiki/Download> and the source code is available at <http://eoxserver.org/browser> or via any Subversion client from <http://eoxserver.org/svn>. The documentation is available at <http://eoxserver.org/doc/> including a demonstration of the functionality at <http://eoxserver.org/doc/en/users/demonstration.html>.

EOxServer is run in a community process lead by a project steering committee (see <http://eoxserver.org/doc/en/rfc/rfc0.html>). Discussions mostly take place on the dev mailing list <http://eoxserver.org/mailman/listinfo/dev/>.

At the time of writing EOxServer is released in a stable 0.1 branch (latest version is 0.1.2, GPL license). Development is ongoing in trunk which will be released in a 0.2 (MIT license) branch and will include lots of enhancements and new features. The stable 0.1 branch is the version tested against the CITE tests (see clause 7).

In a joint code sprint, undertaken by EOX, rasdaman, and Jacobs University, an initiative has been started to use rasdaman as a pixel store instead of flat files. The resulting coupled system will be provided as a preconfigured VM for download.

6.2 GMU Earth Observation WCS v2.0

GMU EO-WCS is an OGC Web Coverage Service for Earth Observation data. GMU EO-WCS implements the OGC WCS 2.0 Interface Standard – Core, and the WCS 2.0 Application Profile – Earth Observation specifications.

GMU EO-WCS is released under the Open License a MIT-style license and is written in the C++ programming language, and entirely based on Open Source software including GDAL, PROJ.4 and HDF-EOS library.

The currently available functionality includes:

- ☐ Support of adopted WCS 2.0 specification (Core including GetCapabilities, DescribeCoverage, and GetCoverage requests, KVP-, and XML/POST protocol binding)
- ☐ Anticipated support of envisaged extensions: Coverage format, GeoTIFF encoding, predefined (or EPSG) CRSs, scaling & interpolation, and non-referenced access. By "anticipating" we mean to reflect the latest WCS.SWG discussions as well as to follow the relevant parts of the previous 1.1 and 1.0 versions of WCS.
- ☐ Support of Dataset Series as a collection of EO Coverages e.g. in a time series
- ☐ Support of new DescribeEOCoverageSet operation on Dataset Series
- ☐ Support of EO Metadata (retrieval and evaluation in DescribeEOCoverageSet operation)
- ☐ Protocol bindings supported:
 - KVP/GET
 - XML/POST
- ☐ Coverage formats supported:
 - GeoTIFF (image/tiff)
 - NetCDF (application/x-netcdf)
 - HDF-EOS (application/x-hdfeos)
 - JPEG2000 (image/jpeg2000)
 - Raster formats supported by the GDAL library

GMU EO-WCS source code can be downloaded from

http://geobrain.laits.gmu.edu/ows8/wcseo/code/gmu_eowcs_v0.1.tar.gz. The documentation is available at <http://geobrain.laits.gmu.edu/ows8/wcseo/doc/>, and a demonstration of the functionality at <http://geobrain.laits.gmu.edu/ows8/wcseo/demo/wcseodemo.html>.

6.3 Limiting result size

In order to prevent the server hardware hosting an EO-WCS service from being blocked by single requests the EOxServer currently applies a limitation on the number of pixels per axis for resulting coverages. This limitation defaults to 2048 pixels for each axis. However, this is maybe not the most appropriate solution especially because it is not standardized but also because it doesn't take into account the rangeType of the coverage.

Thus it is proposed to standardize a limitation possibility in a WCS extension that can be used by service instances based on the rangeType, which means a limitation of the size of the rangeSet.

EO-WCSs serve only 2 dimensional sub-types of GridCoverages. Thus the exact number of pixels (grid points) of a GetCoverage result is known a priori. Multiplied by the number of bands (elements of the rangeType) and the amount of bits each pixel value needs (e.g. 8 for byte, 16 for int16, etc.) this results in the exact number for the size of the

rangeSet. Of course different encodings and compression techniques may significantly reduce this number but it is perfectly suited for a specification on service protocol level.

The server should include such a limitation in the GetCapabilities response in a similar way to the limitation of the number of CoverageDescriptions returned in a DescribeEOCoverageSet response. This can be taken into account by a client requesting, with some basic calculations, only small enough subsets via GetCoverage operations.

7 Conformance testing

7.1 EOxServer

Conformance testing of the EOxServer is done using the stable 0.1 branch. Currently the two OWS-8 demonstration service endpoints (see clause 8) pass all tests up to the test named "wcseo:req46" which happens to be the first one testing an exception.

The current CITE tests run into a problem with the TEAM engine whenever a response reports a HTTP status codes different than 200. However, this behavior is required by OWS Common 2.0, OGC 06-121r9 section 8.6 "HTTP STATUS codes for OGC Exceptions" which is used by WCS 2.0 and thus EO-WCS. For example the request: <http://ows.eox.at/cci/ows?service=WCS&VERSION=2.0.0&request=DescribeEOCoverageSet> responds with the following:

Headers:

```
HTTP/1.1 400 BAD REQUEST
Date: Mon, 22 Aug 2011 13:15:57 GMT
Server: Apache/2.2.16 (Debian)
Vary: Accept-Encoding
Connection: close
Transfer-Encoding: chunked
Content-Type: text/xml
```

Exception:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<ows:ExceptionReport version="2.0.0" xml:lang="en"
xmlns:ows="http://www.opengis.net/ows/2.0">
  <ows:Exception exceptionCode="MissingParameterValue" locator="eoid">
    <ows:ExceptionText>Missing 'eoid' parameter</ows:ExceptionText>
  </ows:Exception>
</ows:ExceptionReport>
```

For more details see this e-mail thread on the CITE forum mailing list:

<http://lists.opengeospatial.org/pipermail/cite-forum/2011-August/000594.html>

8 Demonstration

A demonstration of the EO-WCS functionality is available at the two service endpoints <http://ows.eox.at/cci/ows?> and <http://ows.eox.at/ofc/ows?>. A summary of the available

data and some sample requests can be found at <http://ows.eox.at>. Note that these demonstration services serve data for the OWS-8 demonstration scenarios namely the "Monterey Earthquake emergency response scenario" in the Cross-Community Interoperability (CCI) thread and the "Amazon Drought analysis" scenario in the Observation Fusion – Coverages (OFC) sub-thread.