Heterogeneous Missions Accessibility: Interoperability for Earth Observation

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EO missions

- Earth Explorer
- Global Challenges related to environment and security
- Climate Change
Example of marine service: Marine Monitoring

2006 sea Surface Temperature over the Mediterranean

Credits: Medspiration
Example of atmospheric service: Sciamachy CO₂ Columns

Annual variability of carbon dioxide mixing ratio in parts per million

- CO₂ Columns
- Annual variability of carbon dioxide mixing ratio in parts per million
• A collaborative project started by the GSCB in 2005 with the objective
  
  ▪ To guarantee a seamless and harmonised access to heterogeneous earth observation (EO) datasets from multiple mission ground segments, including national missions and ESA missions.
  
  ▪ To standardise the ground segment interfaces of the satellite missions for easier access to EO data.
  
  ▪ To provide interoperability for coordinated data access enabling the interactions with services or Value Adders and EO Contributing Missions.
• Increased demand for EO data, of different missions

• All EO mission play a vital role in addressing global programmes like GMES and Climate Change

• The number of missions needed to establish the necessary observation capacity for critical services is ever growing,

• Interoperability is needed to reduce the burden to planners and operators!
<table>
<thead>
<tr>
<th>Partner</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASI with the support of Thales Alenia Space</td>
<td>Cosmo-Skymed</td>
</tr>
<tr>
<td>CNES with the support of Spot Image</td>
<td>Pleiades, Spot</td>
</tr>
<tr>
<td>CSA with the support of MDA</td>
<td>Radarsat 2</td>
</tr>
<tr>
<td>DLR with the participation of Infoterra GmbH</td>
<td>Terrasar</td>
</tr>
<tr>
<td>EUMETSAT</td>
<td>Meteo Missions</td>
</tr>
<tr>
<td>ESA</td>
<td>ERS, ENVISAT, Sentinels</td>
</tr>
<tr>
<td>DMCii</td>
<td>DMC</td>
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<td>EUSC</td>
<td>User</td>
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<tr>
<td>EMSA</td>
<td>User</td>
</tr>
</tbody>
</table>
To current status have contributed the Agencies and users, and the work of 25 companies over 10 countries!

- EO collection metadata
- EO product metadata
- Collection and service discovery -> Related activity: ontology
- Catalogue Service
- Order
- Feasibility Analysis
- Online Data Access
- Identity (User) Management
Current EOP Metadata stack

- Other Specific Mission EO Products description
- Catalogue metadata for specific EO mission type
  - OPT
  - SAR
  - ATM
- Catalogue metadata for Earth Observation
  - EOP
- Generic and geometric catalogue metadata
  - Namespaces for radar missions
  - Namespaces for optical missions
  - Namespaces for atmospheric product
- Other Thematic EO Product description

Specific, tight community
- Mission Specific EO Products Viewer
- Thematic EO Products Viewer
- General EO Products Viewer
- Generic GML viewer

Generic, widespread community
Proposed metadata extensions

- Limb-looking products
- Radar Altimeter products
- Systematic and Synthesis Products
- Also opportunity to include metadata elements for existing eop, opt, atm and sar schemas
- Take into account the requirements for Online Data Access metadata (WCS Coverage metadata that will be harmonised with GML coverages)
✓ Establish methodology and standards baseline
  ✓ Model Driven Approach (UML to GML)
  ✓ GML baseline version (GML 3.2.1)
  ✓ Investigate effects of adoption of O&M (ISO 19156) that deprecates gml:observations
  ✓ In parallel start evaluating metadata extensions for the different product types by analysis existing product descriptions that are provided as input

✓ Develop new schemas for new product types and potentially the underlying levels
Services


EO Collections

- ISO 19139:2007, Geographic Information – Metadata XML
- INSPIRE Metadata IR Guidance Document
Annex A – ISO/TS 19139 encoding of the INSPIRE metadata elements

A.1 Introduction

This annex defines the XML ISO/TS 19139 encoding of the INSPIRE metadata elements. This XML encoding is based on XML Schemas derived from the UML models of ISO 19115 and ISO 19119 using the encoding rules defined in ISO/TS 19139 and:

- the XML Schema Implementation of ISO 19115 and the related standards defined in ISO/TS 19139;
- the XML Schema implementation of ISO 19119 defined in CSW2 AP ISO.

The XML encoding of the INSPIRE metadata elements shall follow the instance template defined in chapter 3 and the instructions of chapter 2 with respect to the following instructions.
Datasets

- OGC 06-131: EO Products extension package for ebRIM Profile of CSW 2.0, version 0.2.2, 12/11/2008.
EO Dataset Collections and Services

- OGC 07-038r2: Cataloguing ISO Metadata using the ebRIM Profile of CSW 2.0,
- OGC 07-110r4: ebRIM Application Profile of CSW.
Inspire Conformance Class

- objective: metadata and service model which is semantically aligned with the Inspire Discovery Services
Focus on "discovery"

- fundamental step in any process
- most appropriate link between the INSPIRE information model and HMA model.
Sensor Planning Service dedicated to the EO Sensor domain

The operations implemented are aimed at:

– determining the abilities of the specific server implementation (GetCapabilities),

– requesting the information that is needed in order to send requests (DescribeTasking),

– determining the feasibility of an intended sensor planning request (GetFeasibility),

– submitting such a request (Submit),

– inquiring about the status of such a request (GetStatus),

– requesting information about access to the data collected (DescribeResultAccess).
Objectives: to evolve a consistent interpretation of the OpenGIS Web Map Server standard as a basis for interoperable WMS serving of EO products

To enable and promote interoperability between CSW and WMS services:

- providing users with a mechanism to evaluate EO products before order / dissemination;
- providing users with a seamless process for discovery -> evaluation -> order / dissemination.
OGC 07-063 – Service metadata

Diagram showing relationships between Dataset Series, EO product, Band coverage dataset, Geophysical parameter coverage dataset, Spatial metadata bitmask, DIM, LAYER, TIME, STYLE, and legendURL.
This specification allows submitting orders of the following types:

- Orders for precisely identified EO products, usually derived from a catalogue interaction
- Orders for future EO products, derived from the interaction with an SPS EO compliant server
- Subscription to EO Products: i.e. the user can adhere to a subscription defined from the EO provider / can perform a bulk order for past products

This specification is used in the last step of the normal user workflow (catalogue browsing, future products analysis, ordering), and so it is linked to the specifications used in the previous steps:

- “OGC™ Catalogue Services Specification 2.0 Extension Package for ebRIM Application Profile: Earth Observation Products” OGC 06-131, used for accessing the catalogue
- OpenGIS® Sensor Planning Service Application Profile for EO Sensors OGC 07-018, used for interacting with the on-line programming service instance (SPS EO)
This specification is based on SOAP (V1.1 for HMA implementations) over HTTP POST (Web Service).

Information Model:
- Order options are modelled using SWE Common, in the same way the SPS EO represents tasking parameters.

Interfaces:
- This specification foresees a number of operations (7) for the different tasks of the ordering process.
- The user identity information are carried in the SOAP Header (encrypted and signed) and its format is outside this spec, but it is defined in:
  - User Management Interfaces for Earth Observation Services OGC 07-118 V0.0.4
WCS Web Coverage Service

- EO Application Profile of Web Coverage Service WCS under development.
- Assessment of related activities (« Download service ») in INSPIRE will be done.
Use cases:

- WCS-T (transaction)
  - Get a coverage (all scenes, all subscenes, merged coverage)
  - Add new coverage
  - Update mosaic

Processing
- WCPS (Web Coverage Processing Service)
  - Is the multi-dimensional WCS raster language
  - SQL for coverages": ad-hoc navigation, extraction, aggregation, analysis
Sequence diagram successful authentication

- Authentication Client
- AuthenticationServiceImpl
- LDAP access
- SAMLTokenUtil
- EncryptionUtil

1: authenticate()
2: authenticate()
3: check matching and retrieve data()
4: user data
5: buildSAMLToken()
6: SAML token
7: signElement()
8: signed SAML token
9: cipherElement()
10: encrypted signed SAML token
- Open-source

- It will be available on the SSE Toolbox
Issues

OWSCommon alignment
- OWSCommon 1.0 (OGC 05-008c1): used by Ordering, EO EP, CIM EP, and SPS EO Profile (0.9.5)
- OWSCommon 1.1 (OGC 06-121r3): used by SPS EO Profile 2.0
- OGC 04-016r5: used by OGC 07-118 Version 0.0.4.
- OWSCommon 1.2: vote currently underway...

Asynchronous behaviour
- SPS and Ordering specification use different approaches

OGC Naming Authority policies
- May have impact on several specifications
GMES Data Access: Ontology / Terminology Objectives

- Permit easy identification from non-EO domains (terms) of relevant EO
  - Products / services
  - Processing components

- Ontology
  - As simple as possible
  - Supporting multiple domains
  - With limited dependencies from evolution / changes
  - Possibly permitting multi-lingual support
Product = Packed data or information
Multi-domain Thesaurus

Application Terms can be related to

**themes**

- health
- environment
- climate

**domains**

- deterioration of environment
- natural environment
- marine environment
- terrestrial environment

**information**

- water quality
- oil pollution
- alga bloom

**measures**

- water turbidity
- water transparency
- waves
- wave height
- wave period
- Secchi depth
- alga bloom map
- alga bloom location / extent
- oil spill monitoring
- oil spill surveillance
- oil spill drift forecast

Multi-domain Thesaurus
OGC 06-126 Conformance Test Language

- Now includes support for testing synchronous SOAP interfaces.
HMA TEAM Engine changes published in "HMA" branch on SourceForge.
HMA Contributions to TEAM Engine SVN:

- Implementation SOAP Tag
- Improved test report generation (exportable)
- Extraction test documentation from CTL scripts
CTL test scripts published on public SVN (OGC).
Conformance test engine (TEAM engine) available at:
- http://montgomery.esrin.esa.int

### TEAM Engine
(Test, Evaluation, And Measurement Engine)

- Update CTL scripts from OGC SVN
  - Warning: This will log you out!

#### Select test suite:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Standard</th>
<th>Version</th>
<th>Test Suite Rev</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>OGC 06-131 (EOP EP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Select Profile(s):

Enter Session Description (Optional):

Start a new test session

Problems? Email the webmaster
Scripts deployed are synchronised with OGC CTL SVN repository.

Conformance Testing (CITE) being finalised for:
- Product Catalogue: OGC 06-131 version 0.2.4 and 0.2.5
- Collection Catalogue: OGC 07-038 version 0.1.10 and 0.1.11
- User Management: OGC 07-118 version 0.0.5

Cross testing of all available end-points by all test implementors:
- Test scripts (CTL), list of endpoints, Web interface to run tests accessible from HMA Wiki.
- First version of CTL scripts published on ESA server (August 2009).
• The HMA Architecture Working Group - HAWG is in charge of the Configuration Management and the coordination of the HMA standards between several agencies.

• the HAWG performs two sets of activities:
  ▪ manage the changes / corrections to the current HMA standard documents (i.e manager the evolution of the standards baseline(s))
  ▪ prepare the future evolutions and orientations of the HMA standards.
- Up-to-date list of open-source implementations on HMA Wiki pages

<table>
<thead>
<tr>
<th>Software</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EO SPS Library</strong></td>
<td>This open source project aims at building a JAVA API and library to help the implementation of the Earth Observation Profile of the OGC Sensor Planning Service (SPS). The link to the EO SPS demo page is <a href="http://ws.spotimage.com/labs/HMADemoPage.htm">ws.spotimage.com/labs/HMADemoPage.htm</a>.</td>
</tr>
<tr>
<td><strong>HMA Skeleton</strong></td>
<td>The HMA Skeleton is a tool which provides a configurable simulation framework to simulate HMA (or other) Web services and to test HMA-compliant and OGC compliant client applications. It allows defining response messages and associating response files to incoming request messages using XPath expressions. The tool also contains a simple user interface to send requests to either the skeleton back-end or another HMA-compliant server the address of which is preconfigured in the list of remote servers.</td>
</tr>
<tr>
<td><strong>TEAM ENGINE</strong></td>
<td>The ERGO project has contributed various extensions to the open-source TEAM engine which is used for conformance testing by the OGC.</td>
</tr>
<tr>
<td><strong>EO extension for WMS Reference Implementation</strong></td>
<td>The HMA-T project has published a reference implementation for OGC 07-063 EO Extension for WMS. The implementation will eventually be contributed to the MapServer source base.</td>
</tr>
<tr>
<td><strong>Conformance test scripts</strong></td>
<td>The HMA-T project makes available Conformance test language (CTL) scripts for various HMA specifications. They are maintained on an SVN server managed by the Open Geospatial Consortium.</td>
</tr>
<tr>
<td><strong>GI-Cat Catalogue</strong></td>
<td>The GI-cat catalogue extensions from CNR-IMAA provides an open-source reference implementation of the Earth Observation Extension Package OGC 06-131 and the CIM Extension package OGC 07-038 for CSW webRIM Application Profile.</td>
</tr>
</tbody>
</table>
GSCB Report 2009

This report gives an overview of the Ground Segment Coordination Body (GSCB) activities and describes in more detail the status and achievements of the main projects: the standardisation for Heterogeneous Missions Accessibility, the Quality Assurance Framework for Earth Observation, and the Long Term Data Preservation.

Sensor Web Enablement

Michiel Grothe and Jan Kooljans (Editors)

In their paper 'A testbed for SWE technology' Rowena Smillie, Yves Coene (both Spacebel), Philippe Morigot, Didier Glacobbo (both Spotimage), Stéphane Smolders and Caroline Heylon (both GIM) outline the use SWE technology in a number of projects of the European Space Agency (ESA). They illustrate the maturity of the used SWE concepts in several testbed projects of ESA and GSCB, like the Observations and Measurements standard of the SWE Information model and the application of the Sensor Observation Service and Planning Service. All projects are related to the ESA Services Support Environment (SSE). Issues faced in these projects with the application of SWE concepts are raised by the authors, e.g. missing SOAP bindings in the SWE service specifications. Furthermore, future work on application of SWE within SSE is elaborated on.

Architecture and Services for Computational Intelligence in Remote Sensing


BPEL Cookbook: Best Practices for SDA-based integration and composite applications development
• Join and Share Area http://wiki.services.eoportal.org
• HMA documents available from the wiki and the OGC web site http://www.opengeospatial.org