

# The GIGAS Methodology

Pier Giorgio Marchetti

European Space Agency  
Earth Observation Programme  
Ground Segment Department

[pier.giorgio.marchetti@esa.int](mailto:pier.giorgio.marchetti@esa.int)

- GIGAS has the goal to promote the **coherent and interoperable development of the GMES, INSPIRE and GEOSS** initiatives through their **concerted adoption of standards, protocols, and open architectures** by
  - **Analysing the gaps** between the different initiatives and **proposing strategies** to overcome them
  - **Highlighting best-practice examples** from finished FP6 or ongoing FP7 projects relevant for the identified gaps
  - **Initiating a consensus process** on a broad basis for public consultation and consensus building
  - **Shaping the initiatives** by providing short term action items
  - **Influencing the relevant standardisation bodies** to ensure the long-term action
  - **Providing an agenda for further strategic research areas** to ensure investigation on the problems that are unsolved today

- GIGAS has developed a **detailed methodology to document architecture, process and consensus mechanisms** for each initiative
- This methodology has been used as the basis for **examining requirements, architectures and standards** applied on the systems in order to provide an evaluation of them in terms of business, enterprise, information and engineering and technology architecture, as well as their strategic alignment
- The purpose of GIGAS is not to make studies within each initiative, this is already in the scope of the initiatives and any information can be found inside the initiative documents
- **GIGAS is expected to make a cross-initiative study**, each feature or architectural aspect is analysed not only on a single initiative but across the three initiatives.

## ■ Issues and Objectives

- Make analysis
  - simple and affordable with a limited amount of resources
  - involve participation from different actors: managers, architects, engineers, scientists
- Deals with systems of systems
  - Built independently from each other
  - Long running programmes with independent schedules
- Typical questions
  - Where establish synergy?
  - If and what to merge?
  - How to build interfaces?

- The approach proposed by GIGAS is based on three steps:
  - Technology watch
    - i.e. draw a picture of the current situation
  - Comparative analysis
    - i.e. identify areas with commonalities and/or gaps for interoperability
  - Shaping of initiatives and standards
    - i.e. provide recommendations to initiatives or standardisation bodies or entities
- The above steps will be repeated twice (in two loops) during GIGAS lifetime but can be repeated multiple times after the project conclusion if a persisting infrastructure is established
- This presentation concentrates on the methodology for technology watch, and comparative analysis

- Technology watch
- Comparative analysis

- Define a **common framework to be used for a homogeneous description** of all the GIGAS initiatives, projects and standards in terms of
  - User and system requirements
  - Architecture
  - Data
  - Services
  - Standards
- Use a simple and reusable solution
- Minimise the effort



- An **RM-ODP-based approach** (ISO/IEC 10746) has been selected as a framework for GIGAS Technology Watch as:
  - most of the systems to be compared are based on RM-ODP
  - it supports aspects of distributed processing
  - it aims at fostering interoperability across heterogeneous systems,
  - it tries to hide as much as possible consequences of distribution to systems developers
- The RM-ODP concepts are tailored for the GIGAS needs as:
  - most of the systems to be considered have the characteristic of a “loosely-coupled network of systems and services” instead of a “distributed processing system based on interacting objects”



The RM-ODP defines 5 standard viewpoints

- **Enterprise viewpoint:** A viewpoint on the system and its environment that focuses on the purpose, scope and policies for the system
- **Information viewpoint:** A viewpoint on the system and its environment that focuses on the semantics of the information and information processing performed
- **Computational/service viewpoint:** A viewpoint on the system and its environment that enables distribution through functional decomposition of the system into objects which interact at interfaces
- **Engineering viewpoint:** A viewpoint on the system and its environment that focuses on the mechanisms and functions required to support distributed interaction between objects in the system
- **Technology viewpoint:** A viewpoint on the system and its environment that focuses on the choice of technology in that system

- Specific templates have been created for each viewpoint based on the RM-ODP definitions
- All the different initiatives, projects, standards have been described using the same templates allowing a uniform modeling and a simple comparison
- Same methodology for a two level study
  - System Architecture
  - Individual features/topics (e.g. catalogue, WMS, ordering ..)

## Enterprise Viewpoint Template

- Summary table with project/initiative general features
- High Level Requirements
- Context/Use Cases



## Summary Table

Aspect	Description
Context	The "Heterogeneous Missions Accessibility" (HMA) analyses the requirements, and proposes an approach to allow the desired inter-accessibility across missions forming part of GMES.
Start and End Date	The initial preparatory study "HMA-I" (HMA Interoperability) started in September 2005 and ended in October 2007. <ul style="list-style-type: none"><li>•The CDS EO-DAIL should be operational by 2009 and be available for the GMES FTS services.</li></ul>
Home Page	<a href="http://earth.esa.int/hma">http://earth.esa.int/hma</a> <a href="http://wiki.services.eoportal.org">http://wiki.services.eoportal.org</a>
Summary	<p>The objective of the HMA-I Preparatory study was to define a harmonised access to heterogeneous EO missions' data from multiple missions G/S's, including national missions and ESA Sentinel missions through an access point called EO-DAIL.</p> <p>In the initial phase, high-level requirements and operational scenarios were gathered from ESA, the project partners and the consortium, and a set of consolidated scenarios were produced. The specifications of the architecture and services were then derived from these scenarios and a subset of the requirements was selected for validation by prototyping.</p> <p>In the following phase, the specifications were used to produce the architecture design of the EO DAIL and the ICD's to a selected set of services. These ICD's were then submitted to a standards body for acceptance, giving them an international legitimacy.</p> <ul style="list-style-type: none"><li>•.....</li></ul>
Reference to architecture specification	GMES HMA Architectural Design Technical Note [RD-HMA-5]
Source of Requirements	EADS-Astrium UK and ESA were supported by the contributions of the already identified project partners who have a direct contractual relationship with ESA in HMA :
Business rules (model),	The CDS is providing the interoperability framework and architecture for the operational provision of data access from the national and Eumetsat missions contributing during GMES Space Component Phase 1 to provide the necessary data for the GMES Services.

Security rules	Access control mechanisms embedded in architecture, specification and implementation. See also Technology Watch for CDS User Management.
Authority rules for privileges and permissions	none
Resource usage rules	pilot-specific
Transfer rules,	public specifications, re-use of software components depending on partner
Domain rules	Closed consortium; advisory board with selected users
Important use cases	<p>The CDS and the DAIL in particular focus on the definition of following interfaces:</p> <ul style="list-style-type: none"> <li>◦Collection and Service Discovery service,.</li> <li>◦Catalogue service, t;</li> <li>◦Ordering service, to order products identified in a catalogue;</li> <li>◦Programming Service, to place request for new acquisitions;</li> <li>◦Online Data Access Services, to retrieve products from the online access archives offered through the HMA;</li> <li>◦User Management Services, to manage all information related to a user and access to the services.</li> </ul> <p>Detailed scenarios and use cases for the CDS and EO DAIL were established as part of the HMA-I Preparatory Study.</p> <p>The scenarios can be found in "HMA Scenario Technical Note" [RD-HMA-10].</p>

**Table 62: Enterprise Viewpoint of the GMES CDS EO-DAIL**

## High Level Requirements

The following high level requirements guide the architectural choices of the CDS customer interface and the interaction with the GSC Contributing Missions (GCMs) (source: ESA HMA Software Requirements Review presentation March 2006):

- CDS-CI-GEN-001: The GMES ground segment shall provide the “necessary interfaces for requesting and accessing data from national and Eumetsat missions forming part of GMES”.  
Note: The component publishing these interfaces is named “Customer Interface of the Coordinated Data Access System (CDS)” a.k.a. “Data Access Integration Layer” – DAIL.
- CDS-CI-GEN-002: The architecture shall permit to integrate EO products, space data with all kinds of other data and information.
- CDS-CI-GEN-003: The architecture shall be able to support the GMES Data Policy, which will be defined at a later stage.
- CDS-CI-GEN-003: The architecture shall make no restrictions about user groups, user privileges or data pricing.
- CDS-CI-GEN-004: The overall architecture shall be driven to minimise the cost and impact on GMES Contributing Missions ground segments.
- CDS-CI-GEN-005: The architecture shall be independent of a particular GMES Contributing Mission ground segment.
- CDS-CI-GEN-006: The architecture shall permit its adoption by additional missions in the future.

## Context

This harmonised access is offered through the Coordinated Data access System (CDS) depicted in the figure below. The CDS is limited to providing access to the EO products.

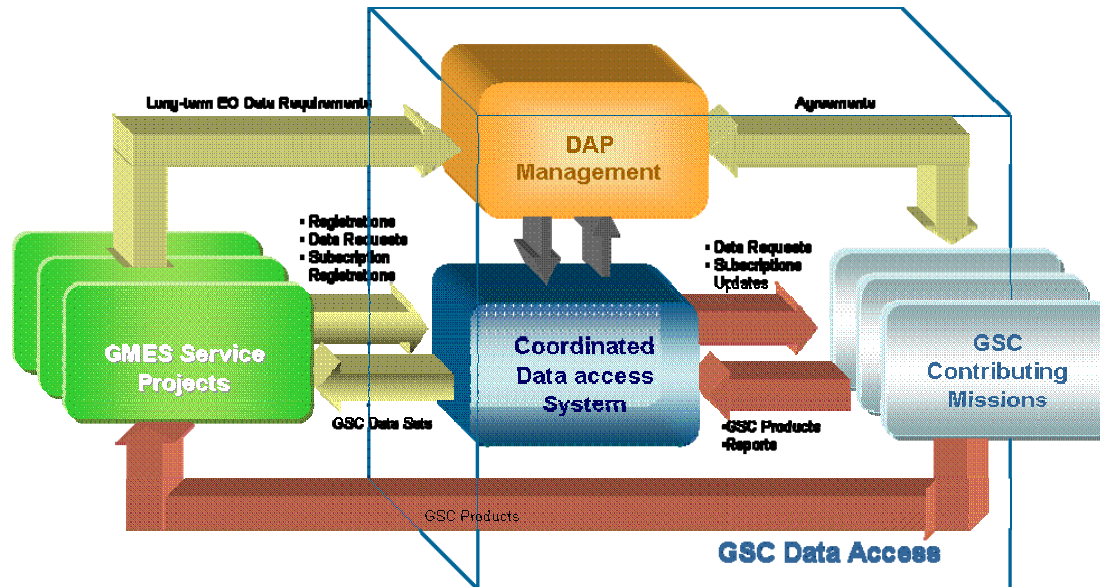


Figure 1:- GMES Space Component Data Access Overview

## Use Case

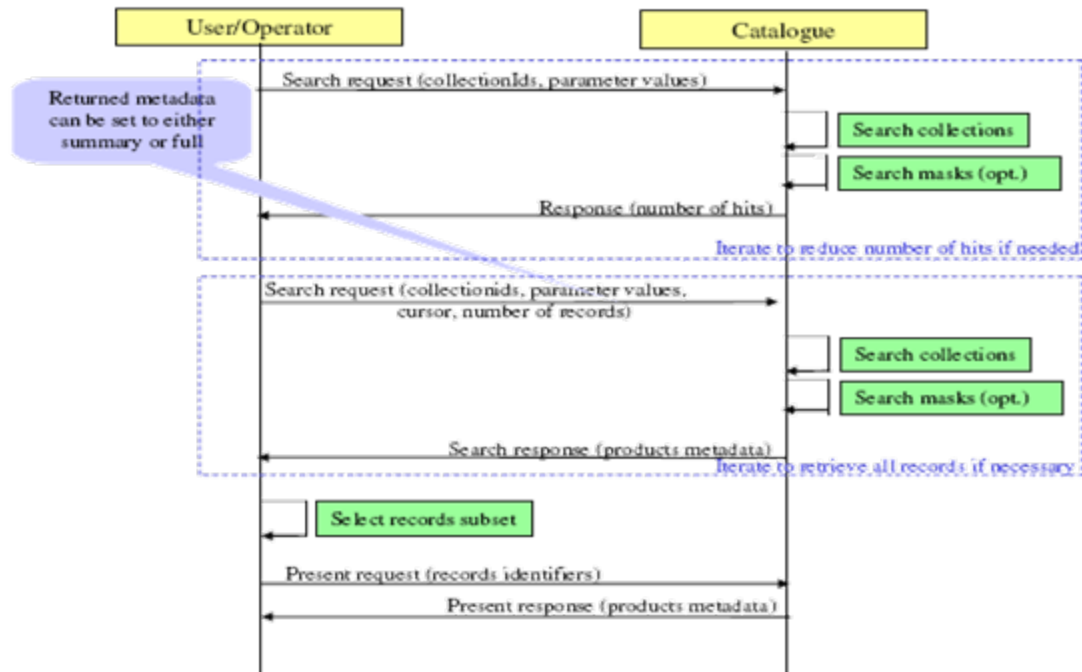


Figure 5.2-3: - US2\_1\_2 - Catalogue Search

The scenario of Figure 5.2-3 describes a typical catalogue search sequence in which the user client would first query the number of hits returned by his search, modifying the request as necessary to reach a practical number.

Once a satisfactory request has been found, the user client would retrieve the records in a brief format by iterating a piggy-backed search request.

The user can then select a subset of the records and issue a present request for the full metadata of selected records.

Note the retrieval of potential masks associated with the product metadata (e.g. cloud cover) (AD05, CNES).

One way of implementing this scenario is for the Replicated Catalogue to hold only a subset of the metadata, e.g. brief or summary, for a quick search response (at the least, this subset should allow the



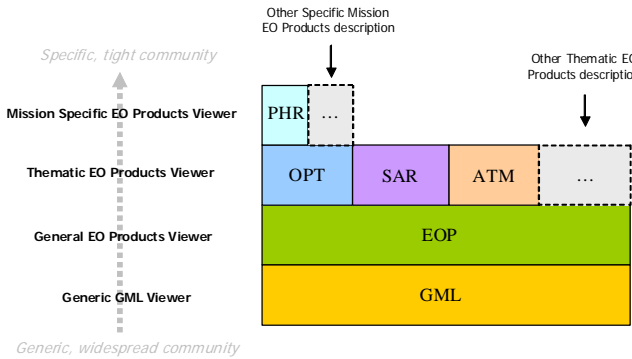
### Information Viewpoint Template

- Set of tables describing data, metadata and data models of each project/initiative

## CDS EO-DAIL Information Viewpoint

Aspect	Description
Model name	Service and Collection Metadata Model
Category	
Reference to specification	
Standard reference	ISO 19115 [RD-HMA-11] ISO 19119 [RD-HMA-12] ISO 19139 [RD-HMA-13] OASIS UDDI [RD-HMA-14]
Description	ISO 19119 defines the model for geographic services metadata, it however does not cater for the XML encodings of these. This is dealt with in the ISO 19139 specification that describes the transformation of the abstract UML models into XML schema. ISO 19139 standards also is used for the XML encoding of EO Collection metadata, another important category of information within our architecture. EO collections are described in accordance with the ISO 19115 model for geographic metadata.
Format	UML, XML ISO 19139 [RD-HMA-13]
Comment	

**Table 63: CDS Service and Collection Metadata Model**

Aspect	Description
Model name	EO Product Metadata Model
Category	Basic model
Reference to specification	
Standard reference	GML (ISO 19136) [RD-HMA-15] OGC 06-080 [RD-HMA-16]
Description	<p>However the most important information model is the one of the EO Product metadata which has been based on OGC's GML (Geography Mark-Up Language) and where the modularity vis-à-vis the different types of missions or sensors has been achieved by defining different application schemas for optical (OPT), radar (SAR) and atmospheric (ATM) that are extending the underlying schemas as described in the following figure.</p>  <p style="text-align: center;"><b>Figure 1:- Layered EO Product Metadata.</b></p>
Format	UML, XML GML (ISO 19136) [RD-HMA-15] OGC 06-080 [RD-HMA-16]
Comment	

### Service Viewpoint Template

- Summary table with the list of services each project/initiative
- Set of tables describing each service of each project/initiative

Aspect	Description
Service meta-model	ISO 19119:2005: The OpenGIS Abstract Specification; Topic 12: OpenGIS Service Architecture
Service Taxonomy	GMES HMA services can be classified according to different perspectives: <ul style="list-style-type: none"> <li>·Human interaction services</li> <li>·Model/Information management services</li> <li>·Workflow/Task management services</li> <li>·Processing services</li> <li>·Communication services</li> <li>·System management services</li> </ul>

**Table 68: GMES CDS EO-DAIL Service meta-model and taxonomy**

Aspect	Description
Service name	Catalogue
Category	Model/Information management service
Reference to specification	
Standard reference	<ul style="list-style-type: none"> <li>◦Dataset metadata: ISO 19115 [RD-HMA-11]</li> <li>◦OGC GML (Geography Markup Language) 3.1.1 [RD-HMA-15]</li> <li>◦OGC 06-080 GML Application Schema for EO Products [RD-HMA-16]</li> <li>◦OGC 07-006: Catalogue 2.0.2 [RD-HMA-17]</li> <li>◦OGC 07-110: ebRIM Application Profile for CSW 2.0.2 [RD-HMA-18]</li> <li>◦OGC 06-131 Extension Package for ebRIM Application Profile of CSW 2.0.2. [RD-HMA-21]</li> <li>◦OGC 07-118: User Management Interfaces for Earth Observation Services [RD-HMA-20]</li> </ul>
Description	<p>This service interface enables GMES Service Projects to discover and retrieve metadata about available Earth Observation (EO) datasets.</p> <p>The returned dataset metadata and queryables map to the GML Application Schema for EO (OGC 06-080) metadata. The interface is extensible for various types of EO data.</p> <p>The current specification covers optical, radar and atmospheric missions as explained in the Information Viewpoint above.</p>
Format	WSDL
Comment	

**Table 70: GMES CDS EODAIL Catalogue Service**

### Engineering Viewpoint Template

- Scenarios expanding use cases
  - Definition of policies (e.g. access control)
- 
- Engineering Viewpoint is less significant from a GIGAS perspective

### Technology Viewpoint Template

- Platforms
  - Runtime Environment
  - Standardisation Process
- 
- Technology Viewpoint is less significant from a GIGAS perspective



- Technology watch
- Comparative analysis

- Based on the outcomes of the previous Technology Watch, GIGAS undertakes a **comparative analysis** on
  - solutions,
  - requirements,
  - architecture,
  - models,
  - processes
  - consensus mechanisms
- used by
  - INSPIRE, GMES and GEOSS,
- taking into account
  - the monitoring of FP6/FP7 research projects
  - the ongoing standardization activities
- searching for gaps and commonalities with the goal of interoperability

<u>Catalogue/Metadata Comparative Analysis</u> <u>Information Viewpoint</u>			
<i>Feature</i>	<b>GEOS</b>	<b>INSPIRE</b>	<b>GMES</b>
<i>Registry Model</i>	ebRIM 3.0	ISO 19135 for existing registers (feature catalogue & glossary)	ebRIM 3.0
<i>Dataset Metadata</i> ( <i>GMES term.: Product</i> )	Profile of ISO 19115	INSPIRE Profile of ISO 19115	Metadata Model & Encoding: EO Profile of GML Discovery information model: EO ebRIM EP
<i>Series Metadata</i> ( <i>GMES term.: Collection</i> )	Profile of ISO 19115	INSPIRE Profile of ISO 19115	Metadata Model: Profile of ISO 19115 (OGC 07-025) Metadata Encoding: ISO 19139 Discovery information model: CIM ebRIM EP
<i>Service Metadata</i>	Profile of ISO 19119	INSPIRE Profile of ISO 19119	Metadata Model : Profile of ISO 19119 (OGC 07-025) Metadata Encoding: ISO 19139 Discovery information model: CIM ebRIM EP

Table 2 – Catalogue/Metadata Comparative Analysis - Information Viewpoint

The result of the Comparative Analysis includes:

- A **technical note** summarising the results of the study
  - The identification of **technological gaps** to be explored in the following shaping phase
  - Guidelines and objectives for the architectural approach within GIGAS
- A set of **draft recommendations** (mainly) to GEOSS, INSPIRE and GMES to be expanded and processed in depth in the following shaping phase
- **Analysis on the schedules** of the three initiatives and on the FP6/FP7 programs and standardization activities, with identification of key milestones or intervention points

### The draft recommendations

- are the main result of the comparative analysis
- are derived from a critical analysis of the technology watch reports
- are extracted, processed and refined on the basis of a set of criteria used to identify priorities:
  - Cost-benefit trade-off for interoperability
  - Governance
  - Schedule
  - Previous feedbacks from the initiatives
  - Long term perspective and global scenario



- Revising existing specifications/standards
- Testing
- Further investigation about the subject
- Communication
- Submission for consideration as reference material
- Funding
- Research
- Governance/Political
- ...

- Initiatives
  - INSPIRE
  - GEOSS
  - GMES (either GSC, FTS or both)
  - SEIS
- Standardisation Bodies
  - ISO
  - CEN
  - OGC
  - ...
- GIGAS Consortium
- ...

REC-[topic-acronym]-[counter] [title of the recommendation]

- It is recommended
  - To [entity]
- [text of the recommendation]
- Rationale: [if any, text of the rationale]
- Dependencies : [if any, text of the dependencies]



### REC-CAT-001 Cross-initiative scenario

- It is recommended to:
  - the INSPIRE, GEOSS and GMES stakeholders
- that they set up a cross-initiative scenario dealing with resource discovery in the context of climate change, with cadastral data obtained from INSPIRE and Earth Observation data obtained from GMES and GEOSS
- Rationale: One of the difficulties of identifying potential interoperability issues between the three initiatives is the lack of known requirements with regard to cross-initiative real-world interactions. Such a scenario would help create a concrete context for the interoperability issues identified in the GIGAS project.
  - Note: the JRC study on cross-catalogue interoperability could be used as input to define this cross-initiative scenario

## REC-WMS-001 OWS SOAP Binding

- It is recommended to
  - OGC and ISO/TC211 and CEN TC287
- to support SOAP/HTTP-POST binding, according to INSPIRE Technical Guidance and related technical documents (e.g SOAP framework), in addition to KVP/HTTP-GET binding
  - Draft Recommendation to FP7 Projects (GMES FTS, NESIS, ...) to
    - Adopt Service Oriented Architecture
    - Use SOAP and WSDL for service binding



### REC-OM-002 SOS support in INSPIRE

- It is recommended that:
  - the INSPIRE CT and Network Service Drafting Team (DT NS)
- consider supporting the Sensor Observation Service (SOS) alongside WFS for the INSPIRE Download Service in relevant themes.
- Rationale: SOS is a more specialised interface than WFS for providing access to O&M-compliant data, and offers a further level of potential interoperability.
- Dependencies: The Download Service Implementing Rule is currently at stage [...] – this recommendation depends on the future opportunities for its review.



## REC-IT-003 SIF European Team

- It is recommended that
  - GIGAS
- supports the creation of the GEOSS SIF European Team and plays a leading role inside
- Rationale: provide the European voice within SIF

# Thank you for your attention

Links to targeted Initiatives, Organisations and Projects:



European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung



Open Geospatial Consortium, Inc.



International  
Organization for  
Standardization



COOPERATION



Sixth Framework Programme



European Information Services  
for Environment and Security



INSPIRE - Infrastructure for  
Spatial Information in Europe



Shared Environmental  
Information System for Europe