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GIGAS Methodology for comparative analysis of information and data management systems

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i. Preface

This document has been written on the basis of a methodology developed within the GIGAS Support Action financed by the European Commission in order to address the convergence of global initiatives like GEOSS and the European interoperability initiatives developed in the context of the GMES programme like HMA - Heterogeneous Missions Accessibility and the INSPIRE spatial data infrastructure legislation.

The GEOSS, INSPIRE and GMES an Action in Support (GIGAS) promotes the coherent and interoperable development of the GMES, INSPIRE and GEOSS initiatives through their concerted adoption of standards, protocols, and open architectures.

The methodology has been applied in the GIGAS project for a parallel analysis of GEOSS, INSPIRE, GMES, FP 6/7 projects and standardisation bodies, see [RD2] and [RD15].

ii. Submitting organizations

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

- European Space Agency
- European Commission Joint Research Center Institute for Environment and Sustainability
- ElsagDatamat)
- Spacebel
- Consiglio Nazionale Ricerche
- Fraunhofer IITB

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Foreword

Statement from Hugo De Groof – European Commission: Directorate-General Environment – Chief Scientist, Research and Innovation Unit

The European Union's 6th Environmental Action Programme 2001-2010 has set the framework for knowledge-based environmental policy making and assessment. It was shown early in the process that priority policy actions related to climate change mitigation and adaptation, the halting of the loss of biodiversity, environment and health and more sustainable strategies for natural resource and waste management require more timely, more accurate and more interoperable sources of information. A number of thematic strategies on the marine environment, pesticides, soils, air quality and the urban environment have led to the review and development of new elements of Community law in these areas, such as the Marine Strategy Directive, the Soils Thematic Strategy, the Pesticides Directive and the Clean Air for Europe Directive to name a few. In addition, following the severe social and economic impacts of natural disasters such as floods and forest fires which occurred with increasing intensity in the last decade, the Community decided on a legal framework for the management of floods and the further development of early warning and disaster response information systems. Together with the more traditional measures for controlling emissions and pollution at the source, a risk management and communication based approach has become a prominent part of the Communities legal framework and initiatives.

To support the implementation of these policies, a number of obstacles related to the availability and the sharing of the required data sources had to be tackled. The INSPIRE directive has led to a roadmap of actions through which the necessary spatial data will become more easily discoverable and accessible for stakeholders having to implement the required information services. The GMES initiative of the Commission and the European Space Agency tackles issues related to collection of the needed data from space and terrestrial observation systems as well as the development of data processing services, which will enrich the data holdings too which stakeholders will have access through the INSPIRE architecture. Both GMES and INSPIRE fit and contribute to the GEO/GEOSS initiative as a regional contribution to the global ambition for developing a Global Earth Observation System of Systems.

The GIGAS project plays an important role in this process as many actors active in these processes need to align their technical developments according to a commonly agreed framework of standards and architectural principles. A 'global to local' shared environmental information space and system requires a high degree of technical convergence and solid guidelines for achieving this are absolutely required.

The GIGAS methodology and comparative analysis is a major contribution to achieving these goals.

Statement from Jay Pearlman, Co-chair, GEO Architecture and Data Committee

GMES, INSPIRE, and GEOSS, are policies and initiatives that are affecting environmental information management, in Europe and beyond. INSPIRE and GEOSS each address a different aspect of the need to have a coherent and sustainable interoperable data and information system that supports informed decision-making. Because of their different formations and approaches, there is not a consistent approach to architecture and interoperability between these activities. For example, there are differing emphases on the degree to which recognized standards play a core role in architecture frameworks.

As part of its mission, GIGAS has examined the development of a consensus process that facilitates communication between GMES, INSPIRE, GEOSS including other European and international programs participating in GEOSS. A key to the process is the coordination with the bodies that develop international standards for geospatial and observational information. However, an effective process must address not only standards, but also the methodologies for understanding, implementing and analyzing the architectures and frameworks used in systems.

This document defines a methodology to be used for analyzing and comparing different information and data management systems. This methodology addresses many aspects of system implementation, allowing evaluations in terms of business, enterprise, information and engineering and technology architecture, as well as their strategic alignment. From this perspective, the methodology has broad implications for the architecture of systems of systems, systems themselves and related components. Bringing together INSPIRE, GMES and GEOSS through the GIGAS project addresses the broad range of application environments that are necessary to test and validate the many aspects of interoperability.

As a Co-chair of the GEO Architecture and Data Committee, I am pleased to express my support for this initiative of the GIGAS project and consortium to promote a methodology for the comparative analysis of interoperable systems. This is a significant effort in defining methodologies that supports the path forward in the GEOSS architecture and interoperability developments and a valuable tool for managing composite and multi-actor scenarios..

Ultimately, the existence and convergence of parallel spatial data infrastructure initiatives, like the ongoing definition of the implementing rules for the INSPIRE Directive, demands a high level of consistency and accepted methodologies, which at European level is addressed in the GIGAS Support Action financed by the Directorate General Information Society of the European Commission.

Introduction

The methodology described into this document is one of the tools that the GIGAS consortium developed to examining the requirements, architectures and standards applied in 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. It has proven to be useful for analyzing and comparing different systems and identifying areas of convergence, technology and interoperability gaps and as a tool for the technical dialogue across different user communities.

GIGAS Methodology for comparative analysis of information and data management systems

1 Scope

Information, including spatial information, is needed for the formulation and implementation of environmental policies and other European Community (EC) policies, which must integrate environmental protection requirements in accordance with Article 6 of the Treaty. In order to bring about such integration, it is necessary to establish a measure of coordination between the users and providers of the information so that information and knowledge from different sectors can be combined.

Measures are therefore required to reduce unnecessary duplication of data collection and to promote their harmonisation and dissemination and use. This should result in increased efficiency, the benefits of which can be reinvested in improving the availability and quality of information, thus stimulating innovation and supporting e-Governance services. Spatial information plays a key-role because it allows information to be integrated from a variety of disciplines for a variety of uses; it is fundamental building block of the emerging electronic participatory approach in democracy and public governance.

Measures are being put in place. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) lays down general rules to establish an infrastructure for spatial information in Europe for the purposes of Community environmental policies, and policies or activities which may have an impact on the environment.

Furthermore Europe is addressing global issues related to the monitoring and management of global change phenomena and the need for security related observations with the GMES (Global Monitoring for Environment and Security) programme for the implementation of information services to support decisions concerning environment and security. GMES is based on observation data received from Earth observation satellites and ground based information. GMES is jointly supported and financed by the European Commission and the European Space Agency (ESA), which develops the Space Component of GMES. In COM(2005)565 "GMES: From Concept to Reality", paramount for the GMES service component is the development of the Spatial Data Infrastructure as envisaged by INSPIRE.

According to COM(2008) 46 "Towards a Shared Environmental Information System (SEIS)", priority will be given to INSPIRE implementation and further development of GMES , as a basis for improving respectively the sharing of environment-related data and information within Europe and the provision of services to public policy makers and citizens.

Moreover, INSPIRE and GMES are contributions of the European Commission to the Group on Earth Observations (GEO) and the related Global Earth Observation System of Systems (GEOSS).

It is evident that INSPIRE, GEOSS, GMES and SEIS are policies and initiatives that are affecting environmental information management, in Europe and beyond. It is imperative that the information and communication technologies (ICT) underpinning the mentioned policy areas be aligned in order to interoperate reliably in a single information space. The project GEOSS, INSPIRE and GMES an Action in Support (GIGAS) contributes to this aim by promoting the coherent and interoperable development of the GMES, INSPIRE and GEOSS initiatives through their concerted adoption of standards, protocols, and open architectures.

This document is one of the tools that the GIGAS consortium developed to examining the requirements, architectures and standards applied in 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. It has proven to be useful for analysing and comparing different systems and identifying areas of convergence, technology and interoperability gaps and as a tool for the technical dialogue across different user communities.

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2 Compliance

Not Applicable.

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.

3.1 Reference Documents

RD 1. Reference Model for the ORCHESTRA Architecture (RM-OA) V2 (Rev 2.1) OGC 07-097

RD 2. GIGAS Technology Watch Report Architecture TN, v104

RD 3. OASIS Reference Model for Service Oriented Architecture 1.0. Committee Specification 1, 2 August 2006. http://www.oasis-open.org/committees/download.php/19679/soa-rm-cs.pdf

RD 4. SANY Sensor Service Architecture (SensorSA) V2, SANY Deliverable 3.2.2, to be published at http://sany-ip.eu

RD 5. HMA Architectural Design Technical Note, HMA-DD-DAT-EN-001, Issue 1.7, 14/09/2007

RD 6. ISO-IEC 10746-1/2/3 Information technology, Open Distributed Processing, Reference model

RD 7. ECSS-E-ST-10-06C 6 March 2009 Space engineering -Technical requirements specification

RD 8. HMA Requirement Baseline Document, HMA-RS-ASU-SY-0001 Issue 1.6

RD 9. Reference Architecture for Space Data Systems Draft Recommended Practice CCSDS 311.0-R-1

RD 10. HMA Scenario Technical Note, HMA-TN-ASU-SY-001, Issue 1.8

RD 11. Information technology — Open distributed processing — Use of UML for ODP system specifications (ITU-T Recommendation X.906 | ISO/IEC 19793:2008)

RD 12. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

RD 13. COMMISSION REGULATION (EC) No 1205/2008, of 3 December 2008, implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata

RD 14. COMMISSION REGULATION (EC) No 976/2009 of 19 October 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the Network Services (Discovery and View)

RD 15. GIGAS Comparative Analysis TN, v101

3.2 Web References

[WR1]. GIGAS public website www.thegigasforum.eu

[WR2]. GMES public website www.gmes.info

[WR3]. INSPIRE public website inspire.jrc.ec.europa.eu

[WR4]. GEO public website earthobservations.org

[WR5]. HMA public website wiki.services.eoportal.org

[WR6]. ORCHESTRA project website www.eu-orchestra.org

[WR7]. SANY project public website www.sany-ip.eu

4 Terms and definitions

Not Applicable

5 Conventions

5.1 Abbreviated terms

CEN	Comité Européen de Normalisation
DGIWG	Digital Geospatial Information Working Group
EO	Earth Observation
FIG	Fèdèration Internationale des Gèometres
FP	Framework Program
GEOSS	Global Earth Observation System of Systems
GIGAS	GEOSS INSPIRE and GMES Action in Support
GMES	Global Monitoring for Environment and Security
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO	International Organization for Standardization
IT WG	Interoperability Tools Working Group

OASIS	Organization for the Advancement of Structured Information Standards
OGC	Open Geospatial Consortium
RASDS	Reference Architecture for Space Data Systems
RM-OA	Reference Model ORCHESTRA Architecture
RM-ODP	Reference Model Open Distributed Processing
RST WG	Refine Scope & Target Working Group
SANY	Sensor ANYwhere
SIF	Standards Interoperability Forum
TBC,	To Be Completed
TBD,	To Be Defined
TBV	To Be Verified
TDWG	Taxonomic Database Working Group
UML	Unified Modeling Language
W3C	World Wide Web Consortium

6 Methodology objectives

The proposed methodology has been developed taking into account a certain number of high level objectives all aiming at ensuring that convergence efforts are directed towards consistent objectives.

The proposed methodology shall

1. empower each community with a neutral tool for comparison and convergence
2. require limited resources for its use and exploitation
3. allow a critical analysis to be performed by the initiative owners both at management and technical level so that decision makers can be involved in the process
4. be scalable as what concerns the number of systems and initiatives addressed
5. allow to analyse and compare the objectives and business models of systems and initiatives,
6. allow to analyse high level requirements, scenarios and use cases,
7. provide an identification of interoperability gaps, areas of possible convergence
8. be tuned towards high level analysis and identification of areas of convergence - the design of the architectures of the contributing initiatives is outside the scope of this methodology
9. be based on the re-use of well known and proven methodologies

As a consequence of the above high level objectives and on the basis of experience the methodology has been based on the re-use for analysis and comparison purposes (i.e. not for system design) of the well known Reference Model for Open Distributed Processing (RM-ODP).

As an example, the applicability of the proposed methodology within the GEOSS context is twofold;

- within the GEO Architecture Data Committee (ADC) it may be exploited to perform a characterization and high level analysis of the architectures of the initiatives and systems contributing to GEOSS thus allowing a more effective discussion on convergence issues and remedies to identified gaps
- within the Standards Interoperability Forum (SIF) the methodology can be exploited to perform a more in depth analysis of interoperability gaps and issues,

possible areas of convergence and opportunities for harmonisation either among the standards or the communities adopting them.

7 Description of Convergence Process

The convergence process addressed by this methodology consists of the following steps:

- Identification of convergence objectives
- Technology Watch
- Comparative Analysis
- Convergence Management

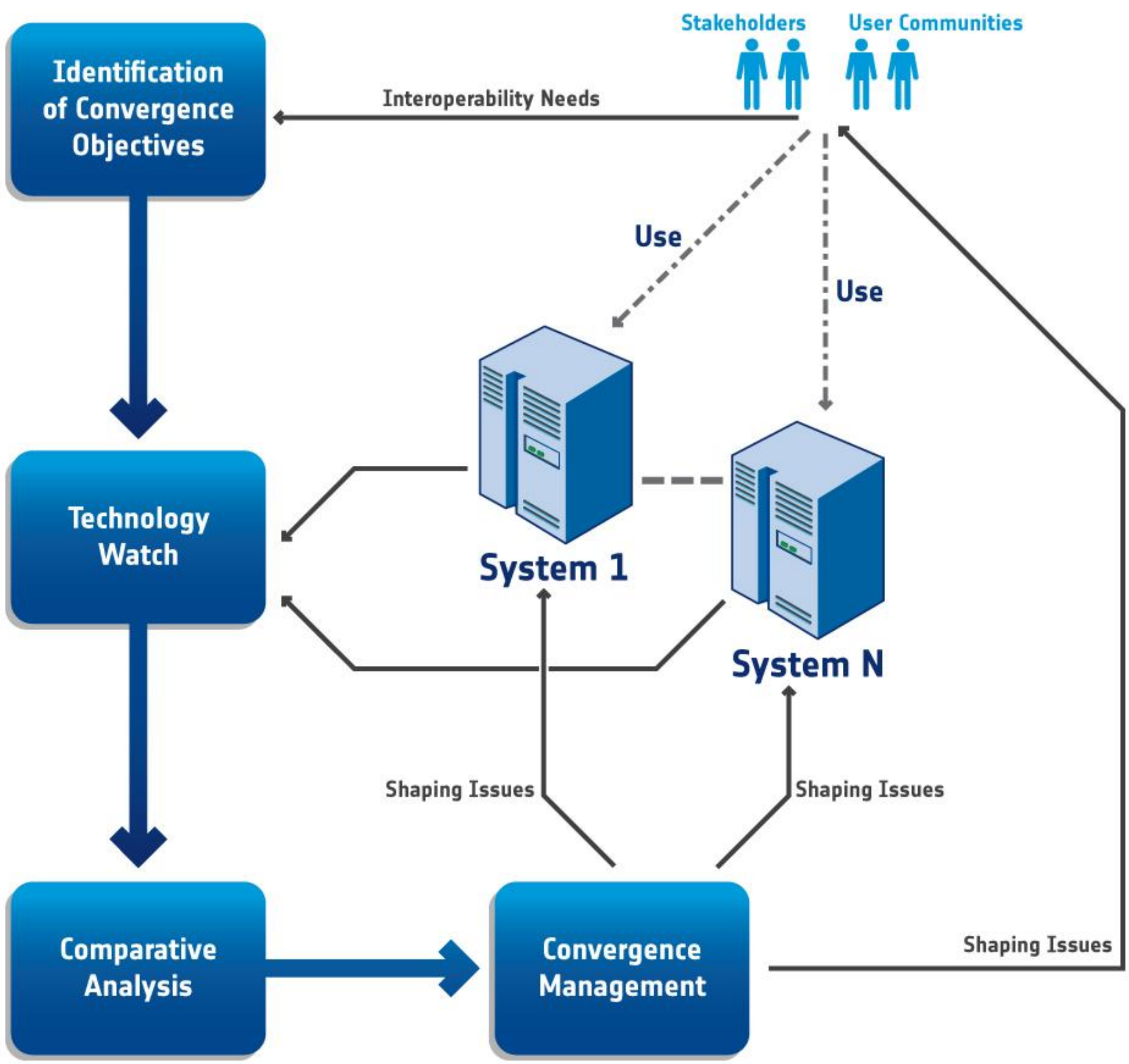

Figure 1 Process Overview

The **identification of convergence objectives** is mainly a collection of the high level requirements aiming to identify the interoperability opportunities among the systems under analysis. The goal is to refine the scope and targets of the activity. The activity involves the so-called stakeholders and user communities (e.g. users or customers or designers or owners etc.) of the systems under analysis, providing their inputs based on their needs.

The **Technology Watch** consists of a parallel monitoring of the target systems in terms of requirements, standards, services, architecture, models, processes and the consensus mechanisms with the same elements of the other systems under analysis.

The Technology Watch will be based on a study using the RM-ODP methodology and the related five viewpoints.

Technology watch is followed by a **Comparative Analysis** on solutions, requirements, architecture, models, processes and consensus mechanisms of the analysed systems.

The result of the Comparative Analysis will include:

- A set of conclusions summarising the result of the study including the identification of technological gaps among the target systems to be explored;
- A list of recommendations/issues for the target systems to be expanded and processed in depth in a possible following Convergence Management phase;
- An analysis on the schedules of the target systems with Identification of key milestones or intervention points, in order to match the necessary deadlines, to provide timely inputs and to receive timely outputs.

Technology Watch and Comparative Analysis result are presented into a technical note.

The **Convergence Management** is the phase of outreach and possibly shaping. The results of the analysis mainly in terms of recommendations and issues are made public and the target systems and stakeholders are addressed. This phase is out of the scope of this methodology.

The above process may be repeated in several iterations.

8 Methodology

8.1 Overview

8.1.1 Introduction to RM-ODP

The RM-ODP (ISO/IEC 10746-1:1998) [RD6] is an international standard for architecting open, distributed processing systems. It provides an overall conceptual framework for building distributed systems in an incremental manner. The viewpoints of the RM-ODP standards have been widely adopted: they constitute the conceptual basis for the ISO 19100 series of geomatics standards (normative references in ISO 19119:2005), and they also have been employed in the OMG object management architecture.

In addition to the viewpoints, RM-ODP defines a language for each of the viewpoints. This methodology is not using the RM-ODP Languages. Consideration will be given to the use of UML in the various viewpoints.

The RM-ODP approach has been used in the design of the OpenGIS Reference Model (OGC 2003) with respect to the following two aspects:

- It constitutes a way of thinking about architectural issues in terms of fundamental patterns or organizing principles, and
- It provides a set of guiding concepts and terminology.

Systems resulting from the RM-ODP (called ODP systems) approach are composed of interacting objects whereby in RM-ODP an object is a representation of an entity in the real world. It contains information and offers services.

Based on this understanding of a system, ISO/IEC 10746 specifies an architectural framework for structuring the specification of ODP systems in terms of the concepts of viewpoints and viewpoint specifications, and distribution transparencies.

The viewpoints identify the top priorities for architectural specifications and provide a minimal set of requirements—plus an object model—to ensure system integrity. They address different aspects of the system and enable the 'separation of concerns'.

Five standard viewpoints are defined:

- The enterprise viewpoint: A viewpoint on the system and its environment that focuses on the purpose, scope and policies for the system.
- The information viewpoint: A viewpoint on the system and its environment that focuses on the semantics of the information and information processing performed.
- The computational viewpoint: A viewpoint on the system and its environment that enables distribution through functional decomposition of the system into objects which interact at interfaces.

- The 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.
- The technology viewpoint: A viewpoint on the system and its environment that focuses on the choice of technology in that system.

The distributed aspect of an ODP system is handled by the concept of distribution transparency. Distribution transparency relates to the masking from applications the details and the differences in mechanisms used to overcome problems caused by distribution. According to the RM-ODP, application designers simply select which distribution transparencies they wish to assume and where in the design they are to apply. The RM-ODP distinguishes between eight distribution transparency types. These distribution transparencies consider aspects of object access, failure of objects, location of objects, as well as replication, migration, relocation, persistence and transactional behaviour of objects.

More recently than the initial publication of RM-ODP, the ISO 19793:2008 standard has been published addressing how to use UML with RM-ODP [RD11]. ISO/IEC 19793 applies UML as an alternative to the viewpoint languages in the original ISO 10746:1998. The ISO 19793 UML is an improvement over the ISO 10746 viewpoint languages. The UML for RM-ODP are useful for the methodology purposes but will not be used directly. The UML for RM-ODP does improve our understanding and use of the RM-ODP viewpoints. In particular two of the summary descriptions from ISO/IEC 19793 are useful for the methodology (See Figure 2):

- The engineering viewpoint addresses: "Solution Types and Distribution - Infrastructure required to support distribution"
- The technology viewpoint addresses: "Implementation - System hardware and software and actual distribution"

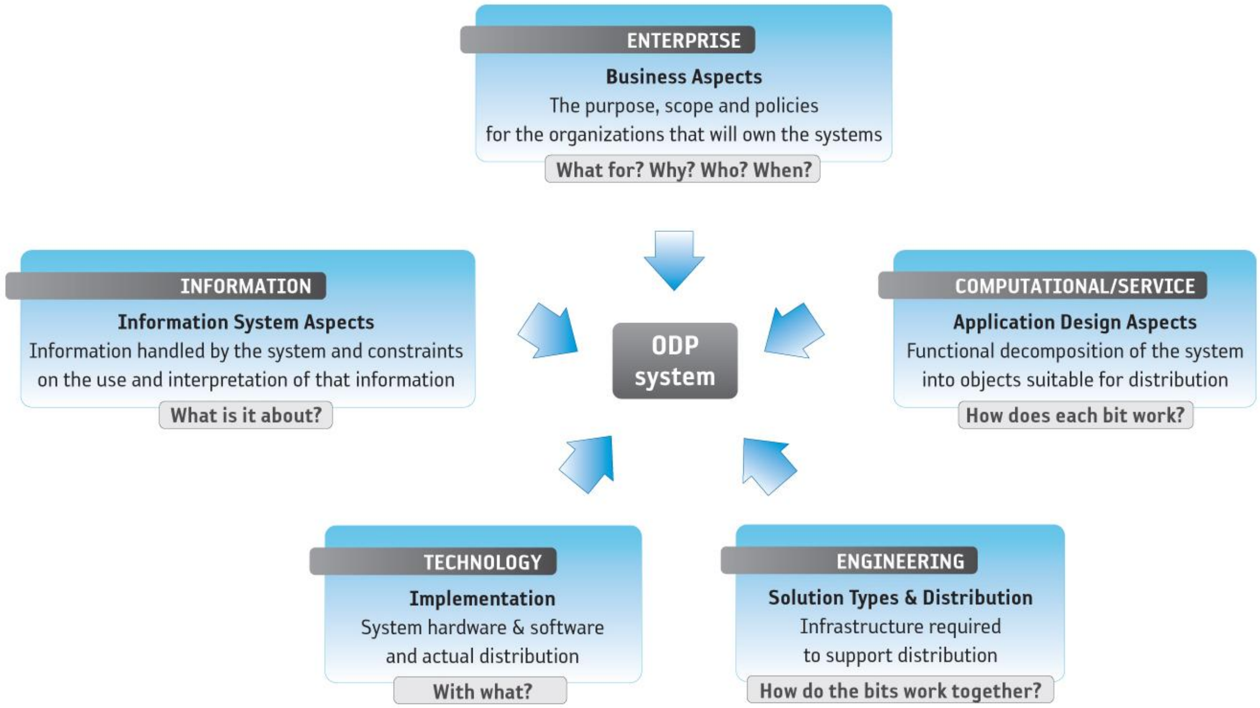

Figure 2 RM-ODP Viewpoints from ISO/IEC 19793

The RM-ODP has been used in the FP6 ORCHESTRA Project [RD1] and in the Heterogeneous Mission Accessibility Project [RD5].

The RM-ODP including the UML version has been used in the GEOSS Architecture Implementation Pilot.

8.1.2 Mapping of RM-ODP to the Methodology

An RM-ODP-based approach has been selected as a structural framework for the Technology Watch step of this methodology. The reason for this choice is as follows:

- RM-ODP is currently popular and widely used i.e. most of the systems to be analysed and compared may already be based on RM-ODP,
- it supports aspects of distributed processing,
- it aims at fostering interoperability across heterogeneous systems, and
- it tries to hide as much as possible consequences of distribution to systems developers.

However, 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 concepts are not followed literally, they rather have to be interpreted and tailored for the purpose. For instance, most of the concepts of the architectures under consideration are not specified in terms of the RM-

ODP distribution transparencies as these are specified in terms of interacting objects instead of interacting services.

The usage of RM-ODP for Technology Watch is two-fold:

1. Architectural analysis: It is used as a common structural means to describe the major architectural characteristics of the projects and initiatives under consideration. This approach enables a comparison and a synopsis of the different architectures on a high level. It is performed for systems of systems, projects and initiatives. Its purpose is to identify possibilities but also major obstacles for interoperability. Furthermore, it identifies the major use cases to be analysed in more detail.

2. Component Implementation Analysis: It is used as a structural means to describe how selected use cases of the projects and initiatives are implemented in the different architectures. This second application of the RM-ODP enables a comparison and a synopsis on a more detailed level. Its purpose is to identify technological gaps and concrete problems of interoperability. It is therefore performed only for selected use cases such as access control or the discovery of services.

An example of GEOSS architectural analysis is presented in annex 2.

The following table contains a mapping of the RM-ODP viewpoints to the methodology elements. In detail:

- The first column provides the original RM-ODP definitions of the viewpoints.
- The second column indicates the mapping of the viewpoints to the technology watch and their interpretation for the next comparative architectural analysis.
- The third and fourth columns provide examples of what will be defined in the viewpoints.

8.2 Identification of Convergence Objectives

The RM-ODP based analysis is assumed to start after a preliminary activity of identification of convergence objectives. This activity is expected to lead to a collection of high level interoperability requirements.

These requirements shall be collected from the analysis of the technical baselines of the systems under analysis and from the user needs of the stakeholders and user communities of the systems under analysis.

In addition a key element will be the expertise of the analysis team and the know-how on the systems and on the relevant interoperability issues.

The identification of convergence objectives aims to select candidate/possible situations where

- Elements/components/aspects show similarities among the different systems allowing an interoperability with (limited) changes
- Aspects of single systems with interoperability barriers towards the other systems which can be removed or bypassed with minor or major effort yielding significant benefits

A preliminary analysis based on a set of criteria should lead to identify the most attractive features/aspects to be analysed in the next RM-ODP study phase. Candidate criteria are:

- Cost-benefit trade-off

  Consider the benefits deriving from the enhanced interoperability with respect to the estimated effort necessary to implement the (technical) solutions needed for removing or reducing the existing interoperability gaps and barriers.
- Governance

  Evaluate the possibility of influencing the systems with the proposed solutions; take into account the level of support provided by the entities governing the systems.
- Analysis team know-how

  Select features/aspects which are well known inside the analysis team, with one or more partners having a solid and consolidated background and expertise across different systems, aiming to arrive to successful interoperability solutions.
- Schedule

  Evaluate if the solutions match with the internal schedule of the systems, i.e. if there are opportunities to frame the outputs into relevant milestones of the systems. E.g. if a system is going to choose a standardisation decision at a certain date, the analysis team may try to propose a solution in time to be adopted by the target system.
- Previous feedbacks

Consider how the systems have taken into account (e.g. immediate adoption, rejection, discussion and next adoption with minor/major modifications etc) previous inputs coming from different sources. Sort the features/aspects giving a priority to those which are envisaged to be accepted by the systems.

- Long term perspective and global scenario

  Try to understand and/or to guess what is happening at global level and what is going to happen not only in the near future but also in the mid-term and in the long term. Try to prioritise features/aspects leading to solutions with expected long term validity. See what happens in other initiatives at world/global level and the general trends in standardisation bodies.

A further effort (if needed/relevant) shall lead to the definition of other requirements, filling gaps and completing the picture (e.g. performance, security, safety, operational, quality).

8.3 Technology Watch

8.3.1 Overview

The following sections describe how to collect and organize information from the systems under analysis using the RM-ODP.

The critical analysis of the high level Interoperability requirements extracted at the previous step aims to drive a study made in parallel on the different systems identifying architectural issues or solutions supporting the scenario in terms of

- removing interoperability barriers,
- facilitating convergence,
- leading to standardisation.

In most cases a complete architectural design is not requested and a basic study identifying key aspects, solutions and design choices is expected.

A key aspect should be surveying the technologies of the selected looking for similarity and differences. Of particular interest will be when systems have similar requirements but have chosen differing technologies that prevent interoperability.

In order to perform a proper survey it is recommended to perform an intermediate step of **terminology harmonisation**.

The editors are expected to provide contributions to the analysis documents according with the templates described into the following sections and they shall reflect the structure of annex 2 of this document, with the same sub-sections and the same framework.

The RM-ODP study shall be made with the aim to provide an output to be compared with similar studies on other initiatives/projects.

As a general rule the RM-ODP study of a system shall be focused on interoperability aspects with the other initiatives.

The example in annex 2 shall be used as a valid input in terms of which structure is expected and what kind of information shall be provided in each section.

The document contributions shall be organised according the five viewpoints of the RM-ODP, i.e.

- Enterprise viewpoint,
- Information viewpoint,
- Service viewpoint
- Engineering Viewpoint
- Technology Viewpoint

The sections for each viewpoint shall be prepared using

- the criteria outlined into the following sections “objectives”
- the templates specified into the following sections “documentation”.

The example in annex 2, both in terms of structure and contents, shall be a valid support and starting point for the analysis.

View-point Name	Definition according to ISO/IEC 10746 & ISO/IEC 19793	Mapping to the technology watch and comparative analysis	Examples for the Architectural Analysis	Examples for the Component Implementation Analysis
Enterprise	Concerned with the purpose, scope and policies governing the activities of the specified system within the organization of which it is a part.	Refers to the application domain, the supporting initiative and/or stakeholders, the purpose and scope of the architecture, the major design constraints (system requirements and architectural principles) and user requirements. Includes policies and rules that govern actors and groups of actors, and their roles.	Mission of GEO initiative INSPIRE Directive Terms of Reference for the development of INSPIRE Annex II and III data specifications Environmental Risk Management as the application domain of ORCHESTRA	INSPIRE Metadata Regulation INSPIRE Network Services Regulation for Discovery and View Security policy for a selected GMES service
Information	Concerned with the kinds of information handled by the system and constraints on the use and interpretation of that information.	Summarise the modelling approach of all categories of information the architecture deals with including their thematic, spatial, temporal characteristics as well as their metadata. Provide the list of standard and proprietary information models that are applied.	Application of the ISO/OGC General Feature Model as information meta-model Appliance of a Model-driven Architecture (MDA) approach starting with UML and a defined mapping to XML schema. Application of the Observation and Measurement model (OGC 06-022r1)	Application of an ebRIM extension package as meta-information schema of an OGC Catalogue Service Specification of access control permissions in XACML
Computational	Concerned with the functional decomposition of the system into a set of objects that interact at interfaces – enabling system distribution.	*Referred to as "Service Viewpoint"* Summarise the modelling approach of Interface and Service Types. Provide the list of standard and proprietary interface and service specifications. Organise them in a service/interface taxonomy.	Service meta-model of RM-OA (OGC 07-097) List of OGC Sensor Web Enablement services specified by the SANY and the OSIRIS projects. Classified into the ISO 19119 Service Taxonomy	Reference to the OGC Catalogue Service used List of services supporting the implementation of access control.

View-point Name	Definition according to ISO/IEC 10746 & ISO/IEC 19793	Mapping to the technology watch and comparative analysis	Examples for the Architectural Analysis	Examples for the Component Implementation Analysis
Engineering	Concerned with the infrastructure required to support system distribution. Solution Types and Distribution - Infrastructure required to support distribution"	Component Types: allocation of services and data allocated to component types. Dynamic: Use cases interaction diagrams Description of the distributed computing environment that supports the interaction between component instances Engineering policies: defining a set of relevant aspects that we are interested to, e.g. Access control, security, etc.)	Identification of Component types for each initiative Description of the components in terms of services from the service viewpoint and information from the information viewpoint. Characterise service platforms according to the OASIS SOA Reference Model	Identify the component types involved in the use case including the services and information types deployed by the components to meet the use case. Sequence diagram to show the coordination of activities between the components needed to meet the use case.
Technology	Concerned with the choice of technology to support system distribution.	Component instances that implement the component types from the Engineering Viewpoint. Products that implement the component instances. Standardisation process used in the initiative in order to develop the RM-ODP design in accordance with international standards.	The service viewpoint describes a catalogue service, e.g., CSW, that is deployed in a community catalogue component type; the Technology viewpoint lists instances of the component and the products used, e.g., FEDEO Clearinghouse and GeoNetwork V2.0, ESRI ArcGIS, Description of the deployment environment for communications: internet, satellite broadcast, media delivery Description of how the GEOSS SIF process.	

Table 1 Mapping of the RM-ODP Viewpoints to methodology

Note: In order to highlight the fact, that the architectures under consideration have often the nature of a loosely-coupled distributed system based on networked services rather than a distributed application based on computational objects, the "computational viewpoint" is referred to as "service viewpoint" in the methodology.

Note: The use of RM-ODP shall be tailored in order to take into account that each of the systems is predominantly, but not exclusively SOA. For example the GEOSS architecture includes data delivery by broadcast and by media.

CCSDS has produced a tailoring of the RM-ODP for space data systems, the Reference Architecture for Space Data Systems [RD9]. RASDS provides guidelines for the description of space data systems that take into account the realities of operating in the space environment. RASDS directly addresses the fact that some elements of these distributed systems will be operated at great distances from one another with one-way light times measured in tens of minutes or hours, not milliseconds. These elements may only occasionally be in contact with one another, typically require use of very expensive and over-subscribed ground communications assets, and are strongly affected by the physical environment in which they have to operate. These environmental issues affect what must be done to provide reliable communications between elements, how control interactions may be designed, and how these systems may be operated.

In addition, Annex 5 contains a mapping of the RM-ODP viewpoints on the GEO AIP viewpoints.

8.3.2 Enterprise Viewpoint

8.3.2.1 Objectives

The Enterprise Viewpoint shall focus on the purpose, scope and policies of the system under analysis.

The Enterprise Viewpoint represents the system in the context of the business environment in which it operates. It is represented by a community of enterprise objects and by their roles (e.g. users, owners and providers of information).

The Enterprise Viewpoint starts with the critical analysis and the refinement of the high level interoperability requirements identified by the previous phase. The rules specified in Annex 3 for writing requirements are a valid support for the successful result of this activity.

In addition, the chosen approach for enterprise viewpoint is to apply use cases as a modelling tool. The concept of use case is adopted from the UML modelling approach.

For each system under analysis create one or more interoperability use cases.

The use case shall:

- describe the behavior of the initiatives,
- identify external actors/interfaces,
- be focused on interoperability issues.

The following topics should be tackled by the use case description, selecting those which are relevant for the scenario under analysis

- Customer identification and needs, high level objectives & requirements

  Which are the external actors of the scenario, in particular the final targets of the service/data; which are their requirements at user level.

- Architecture & Interoperability Barriers

  Identify specific architecture solutions or issues relevant for the interoperability scenario; identify barriers preventing or reducing interoperability.

- Operational Concepts

Identify any operational issue or constraint which may affect the interoperability scenario.

- Standards, Maturity, Planning, Strategy for Implementation/take-up

  Make an inventory of the existing standards relevant for the scenario, evaluate their completeness and maturity, as well as their or weak points; analyse their diffusion, scope and applicability; identify areas needing a (further) standardisation and sketch a possible plan and/or a strategy for implementation or take-up at the relevant levels.

- IPR, Data Policies, Identity Management, Information Security,

  Dealing with interoperability of large systems/systems of systems it is of paramount importance the analysis of issues affecting IPR and data policies as well security issues in terms of user/identity management and information security.

- Test Conformance,

  Identify any issue related to conformance testing, the need of a conformance test platform, i.e. a persistent testbed, consider sustainability and governance. In case of standardisation extend the concept of conformance testing to certification.

- Governance.

  Analyse any aspect of governance also in the perspective of a future shaping.

8.3.2.2 Documentation

The enterprise viewpoint section of the document shall consist of the following subsections:

- Summary Table: a description the system under analysis to be provided using the table in Annex 2.1, which is self explanatory and provides a top level description. The summary table is significant for analysis on systems or systems of system; it is not mandatory for studies at subsystem or component level.

- Context: A description of the overall context,

- The list of the high level (interoperability) requirements,

- The identified interoperability use cases described with the tables based on the template in annex 1.

8.3.3 Information Viewpoint

8.3.3.1 Objectives

The Information Viewpoint shall describe any data/metadata relevant for the scenario under analysis with a parallel view of what happens in the different initiatives.

The Information Viewpoint summarises the modelling approach of all categories of information the architecture of a given project or system deals with. This includes the way how information models are specified, i.e. the set of rules and the notation that is used in order to define information objects and their relations among them. Sometimes this approach is summarised as a meta-model for information. An example of such a meta-model is the General Feature Model (GFM) as specified in ISO 19109 and applied in the OGC Reference Model (OGC 03-040).

The resulting information models (sometimes also called application schemas) include object types (in the GFM called feature types) that include thematic, spatial, temporal characteristics as well as their meta-data. It shall be distinguished between models on the abstract or on concrete service platforms (to be described in the technology viewpoint).

8.3.3.2 Documentation

The information viewpoint of the system under analysis shall be provided by

- Identifying the list of information models of the initiative/project which are relevant for the interoperability scenario under investigation
- describing each information model with the same tables in Annex 2.2.

The editor shall provide a description in terms of information models of his system with the same type of information present in the example in the annex.

The information modelling approach of a project/initiative shall be analysed according to the following list:

- model name
- category
    - One of the following categories shall be used
        - meta-model for information (e.g. the OGC General Feature Model), i.e. guidelines and rules how to specify information models resp. application schemas
        - meta-model for services (e.g. the ORCHESTRA Service meta-model), i.e. guidelines and rules how to specify services and interfaces
        - basic model, i.e. generic application schemas that need refinements for a specific application domain. Example: OGC Observations & Measurements Model
        - thematic model, i.e. an application schema for a particular application domain (e.g. forest fire risks), built according to the meta-model for information
        - meta-information model, i.e. the model used for expressing meta-data/meta-information. Example: ISO 19115 or ISO 19119

- reference to specification
    - reference to a document (if applicable)
- standard reference
    - reference to a standard (if applicable)
- description
    - purpose of the model
    - list of the major object types
- format
    - specify the model in terms of format, (e.g. the following are examples of formats to be used UML, XML, OWL, database schema, textual etc.)
- comment

In addition UML diagrams may be provided on a case by case basis in order to complete the picture.

8.3.4 Service Viewpoint

8.3.4.1 Objectives

The Service Viewpoint summarises the modelling approach of the Interface and Service Types. This includes the way how interface and service models are specified, i.e. the set of rules and the notation that is used in order to define services. Sometimes this approach is summarised as a meta-model for services. An example of such a meta-model is the meta-model for services as specified in the Reference Model for the ORCHESTRA Architecture (RM-OA) [RD1].

The resulting service models include the interfaces of the services, their operations as well as operation parameters and exceptions. Furthermore, it encompasses meta-information about the services, e.g. OGC capabilities It shall be distinguished between services on the abstract or on concrete service platforms (to be described in the technology viewpoint).

8.3.4.2 Documentation

The service viewpoint of the system under analysis shall be provided by

- Identifying the list of services of the initiative/project which are relevant for the interoperability scenario under investigation
- describing each service with the same table used in Annex 2.3.

The partner shall provide a description in terms of services of his project/initiative with the same type of information present in the example in the annex.

Before listing the service and interface types, it shall be specified

- if and if yes, which service meta-model is being used, i.e. which models and rules are applied for the specification of services and interfaces.

  Example: Reference to “W3C Web Service Architecture” or “OASIS Reference Model for Service Oriented Architecture 1.0” or “Reference Model for the ORCXHESTRA Architecture (RM-OA) OGC 07-097”

- if and if yes which service taxonomy has been applied for the project/initiative.

  Example: ISO 19119 Service Taxonomy or SANY Functional Domains

The services of a system shall be analysed according to the following list of items:

- name of service or interface type
- Geographic Service Category
  - One of the following categories shall be used
    - Geographic human interaction services
    - Geographic model/information management services
    - Geographic workflow/task management services
    - Geographic processing services
    - Geographic processing services – spatial
    - Geographic processing services – thematic
    - Geographic processing services – temporal
    - Geographic processing services – metadata
    - Geographic communication services
    - Geographic system management services
- positioning in the project service taxonomy according to
  - ISO 19119:2005 Geographic Information Services
  - service category (e.g. as in ORCHESTRA)
  - project-specific service taxonomy (if applicable, see above)
- standard reference
  - reference to a standard (if applicable)
- description
  - purpose of the service (max. 50 words)
- format of interface specification

    - specify the service in terms of interface format, (e.g. the following are examples of formats to be used UML, WDSL, Java, textual etc.)
- comment

8.3.5 Engineering Viewpoint

8.3.5.1 Objectives

The Engineering Viewpoint focuses on the mechanisms and functions required to support distributed interactions between resources (e.g. services) in the system.

The engineering viewpoint of each system should

- allocate services and data to component types and instance
- list all those major architectural features for which there is a defined workflow, policy or service interaction model and model them in UML sequence diagrams.

The Sequence Diagrams model the systems and their external interfaces exchanging messages according with the interoperability schema under analysis.

8.3.5.2 Documentation

In the tailoring proposed by this methodology (see annex 2.4) the Engineering Viewpoint is assumed to describe:

- Component Types: allocation of services and data allocated to component types.
- Description of the distributed computing environment that supports the interaction between component instances
- Engineering policies: defining a set of relevant aspects that we are interested to, e.g. Access control, security, etc.). Their dynamic behaviour may be described in terms of use cases and service interaction diagrams, e.g. as UML sequence diagrams.
- Implementation Architecture: defining the architecture of the system and how the instances of the component types are allocated and implemented.

8.3.5.2.1 Component Types

This viewpoint describes how the mapping of abstract service specifications and information models to the chosen component types.

The component types define the packaging approach for deployment. Systems have in some cases already defined component types so this viewpoint provides a description of those components by abstracting the implementation details and focusing on the interfaces and information content.

8.3.5.2.2 Distributed Computing Environment

This section describes the distributed computing environments used in the systems. In case of a service-oriented environment it describes the choices of the service platforms with their major characteristics (e.g. architectural styles).

As a general guideline, the specification of a service platform shall be conformant to the OASIS Reference Model for Service Oriented Architecture 1.0 [RD3]. This implies that the platform is being described according to the SOA-RM by the following predefined platform properties (examples for a W3C Web Services platform as applied in the SANY Integrated Project [RD4] are given for the individual properties, respectively):

- Platform Name

  Name of the platform and if applicable the exact version number of the platform specification.
  In the case of a standard platform, a reference shall be provided.

  Example: "W3C Web Services Platform" following the Web Service infrastructure as defined by the W3C specifications

- Reference Model

  If the platform specification is based on a specific reference model, the name and the exact version number of the reference model shall be provided.

  Example: W3C Web Services Architecture

- Interface Language

  Specification of the formal machine-processable language used to define Service Interfaces. In the case of a standard language, a reference shall be provided.

  Example: Web Service Description Language (WSDL), Version 1.1

- Execution Context

  Specification of the Execution Context. The Execution Context is an agreement between service providers and consumers. It contains information that can include preferred protocols, semantics, policies and other conditions and assumptions that describe how a service can and may be used. This includes, for example, the specification of the transport and the security layer, the format of the messages exchanged between service providers and consumers, etc. In the case of a standard Execution Context, a reference shall be provided.

  Example: The execution context of the W3C Web Services Platform is defined by the following properties:

  - Transport Protocol and Message Format:

    SOAP 1.2 HTTP binding as defined in SOAP Part 1: Message Framework, Version 1.2 and Hypertext Transfer Protocol (HTTP), Version 1.1. The message style that shall be used is document/literal non-wrapped since it is the most widely accepted and interoperable message style.

- Security

  Session Information: The transport of session information may be accomplished by using platform specific mechanisms, for example the inclusion of a session key in the SOAP header.

  Encryption: Optional encryption of SOAP messages shall be accomplished by Web Services Security: 4 SOAP Message Security 1.1.

- Schema Language

  Specification of the schema language used to define Information Models.

  Example: Extensible Markup Language (XML) 1.0

- Schema Mapping

  Specification of how to map the abstract level (UML) to the schema language used for this particular platform (if applicable).

  Example: ISO 19136 for GML

8.3.5.2.3 Engineering policies

This section is expected to define the engineering policies applied on a set of relevant aspects that we are interested to.

The engineering policies describe rules, constraints, recommendations or (real-life) examples of service interactions in order to fulfil a given task, e.g. access control for operation calls, or monitoring of services. All these policies must rely upon specifications provided in the Information and/or Service Viewpoint.

These specifications may be

- abstract (i.e. platform-neutral) or
- concrete (i.e. platform-specific)

depending on the level of abstraction to which the system/component/architecture specification belongs to.

For instance, a project and/or an initiative may define policies for the following aspects (non-exhaustive list):

- resource discovery
- service monitoring and management
- access control
- processing of quality information

- event generation and handling

The Engineering Viewpoint shall describe any processing relevant for the engineering policies, preferably if available in UML sequence diagrams. An example is a defined workflow for access control or for the discovery of services based on registries/catalogues. Each policy of the enterprise viewpoint shall be expanded into one or more sequence diagrams detailing the interactions among the actors.

Sequence Diagrams model the initiatives and their external interfaces exchanging messages according with the interoperability schema under analysis, with a parallel view of what happens in the different initiatives.

The focus shall be on the Interoperability aspects to be modelled, identifying barriers but also commonalities

If necessary other type of information can be provided as integration in order to provide a more complete picture.

8.3.5.2.4 Implementation Architecture

This section describes concrete arrangements of component types following the engineering policies and based upon component implementations and the run-time environment identified and described in the Technology Viewpoint.

The rationale of this section is to describe how the component types are combined into a system architecture in order to implement data and services/operations described into information and service viewpoints.

For clarity sake, Section "Component types" lists and describes each type of component one by one; section "Implementation architecture" describes how the building blocks (component types) are assembled and perform the interactions described into the section "Engineering policies".

Note that this section may be empty if a project or and initiative stays on an abstract architectural level. An alternative in this case may be to describe an implementation architecture of a pilot application as an example.

8.3.6 Technology Viewpoint

8.3.6.1 Objectives

The technology viewpoint of the system under analysis shall be provided by defining

- the run time environment
- the status of the standardisation process (if any)

8.3.6.2 Documentation

The Technology Viewpoint deals with the following items relevant for the interoperability scenario:

- Component Implementation
- Run-time environment
- Deployed Service Instances and Service Networks.
- Standardisation processes.

The editor shall provide a description in terms of technology baseline of his project/initiative with the same type of information present in the example in the annex 2.5.

8.3.6.2.1 Component Implementation

This section shall give implementation details on the components types identified into the engineering viewpoint. Details include:

- The tools that support the implementation of the component types;
- The products that provide implementations of the component types.

8.3.6.2.2 Deployed Service Instances and Networks

This section contains the listing of the service instances and service networks deployed by the Initiatives. A service network is hereby considered as a set of service instances (also called a domain) that follows a common set of engineering policies as defined in section 8.3.5.2.3

8.3.6.2.3 Run-time environment

This section shall provide information about the software components (e.g. product name) that is being used as the run-time environment for the service instances and service networks.

Examples: EJB Application Server for services, ESA SSE for the client applications.

The relevance of the run-time Environment on the scope of the activities will be evaluated on a case by case basis.

8.3.6.2.4 Standardisation Process

This section shall provide information about past, ongoing or planned standardisation activities of a project or an initiative. The list shall be concrete in the sense that it may be officially referenced as a new work item, discussion paper, draft specification, recommendation, request for comment, depending on the rules of the standardisation body, respectively. Each item in the list shall include the date of the original submission and the current status accompanied by a date.

8.4 Comparative Analysis

8.4.1 Overview

The comparative analysis task consists of a critical analysis of the technology watch reports, i.e. a set of parallel analysis on the different initiatives of features and architecture aspects. The comparative analysis expected outputs are

- A conclusion at the end of the technical note summarising the result of the study including the identification of technological gaps and guidelines and objectives for the harmonisation approach

- (optional) A list of recommendations/issues to the target systems to be expanded and processed in depth in a future convergence management (shaping) phase; the issues are based on the analysis on the schedules of the systems in order to match the necessary deadlines, to provide timely inputs and to receive timely outputs.

8.4.2 Comparative Analysis Section in Technical Note

The Comparative Analysis section of the technical note consists of a synthesis of the technology watch studies performed for the different systems.

The section shall identify the most significant gaps and commonalities coming out from the technology watch describing interoperability issues and opportunities.

The section contains the following sub-sections:

- Overview

  A summary of the previous technology watch report activity, consisting of a short description of the analysed systems and the most relevant issues detected.
- Opportunity for Interoperability

  A focus on the most significant interoperability issues coming out from the technology watch activity.
- Comparative Analysis

- A parallel analysis on the systems and on the features candidate for interoperability. For clarity sake it is suggested to use matrixes with features/systems as rows/columns for an immediate view on gaps and commonalities. See example in table below from [RD15]

- Open issues and future work items

  It lists issues remaining open waiting for new studies.

Catalogue/Metadata Comparative Analysis **Information Viewpoint**			
Feature	**GEOSS**	**INSPIRE**	**GMES CDS EO-DAIL**
Dataset Metadata (GMES term.: Product)	ISO 19115:2003 is identified as "the" standard for geospatial metadata. Based on experiences in the AI Pilot, it is expected that a profile for GEOSS metadata will be considered and informed by the following existing profiles and packages: ebRIM, BASIC, CIM and EO.	INSPIRE Profile of ISO 19115:2003	Metadata Model & Encoding: EO Profile of GML (OGC 06-080) Discovery information model: EO ebRIM EP (OGC 06-131)
Series Metadata (GMES term.: Collection)	Same as for dataset metadata	INSPIRE Profile of ISO 19115:2003	Metadata Model: Profile of ISO 19115:2003 (defined in OGC 07-025) Metadata Encoding: ISO 19139:2007 Discovery information model: CIM ebRIM EP (OGC 07-038)
Service Metadata	Specific profiles of ISO 19119:2005 and ISO 19119:2005/Amd 1:2008	INSPIRE Profile of ISO 19119:2005 and ISO 19119:2005/Amd 1:2008	Metadata Model : Profile of ISO 19119:2005/Amd 1:2008 (defined in OGC 07-025) Metadata Encoding: ISO 19139:2007 Discovery information model: CIM ebRIM EP

Table 2 Example of Comparative Analysis table

8.4.3 Issues and recommendations

8.4.3.1 Overview

The list of issues (or recommendations) may be extracted as a final result of the comparative analysis on the basis of a critical analysis of the technology watch reports based on a set of criteria used.

Issues are suggestions addressed to relevant entities with the purpose of improved interoperability.

The following types of issues are envisaged:

- Revising existing specifications/standards
- Perform (additional) testing on subjects

- Further investigation about the subject
- Communication
- Submission for consideration as reference material
- Funding
- Research
- Governance/Political
- (Other TBD)

The entities to be addressed are mainly the teams in charge of the target systems.

8.4.3.2 Criteria

The following criteria are envisaged to define issues/recommendations and to identify priorities:

- Cost-benefit trade-off

  Consider the benefits deriving from the enhanced interoperability with respect to the effort necessary to implement the solutions in the issues removing or reducing interoperability gaps and barriers.
- Governance

  Evaluate the possibility of influencing the systems with the proposed issues; take into account the level of support provided by the entities governing the systems.
- Schedule

  Evaluate if the solutions specified by the issues match with the internal schedule of the systems, i.e. if there are opportunities to frame the outputs into relevant milestones of the systems. Consider also if the study timeframe is compatible with the time necessary to complete or at least to start-up a successful standardisation process or a shaping activity.
- Previous feedbacks from the systems

  Consider how the systems have taken into account (e.g. immediate adoption, rejection, discussion and next adoption with minor/major modifications etc) previous inputs coming from different sources. Sort the issues giving a priority to those which are envisaged to be accepted by the systems.
- Long term perspective and global scenario

  Try to understand and/or to guess what is happening at global level and what is going to happen not only in the near future but also in the mid-term and in the long term. Try to prioritise issues leading to solutions with expected long term validity. See what happens in other initiatives at world/global level and the general trends in standardisation bodies.

8.4.3.3 Syntax

The issues/recommendations shall follow specific rules for a not ambiguous identification and clear wording.

For the identification a possible schema is the following

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

i.e REC-CAT-001 Harmonising catalogues

In annex 4 it is presented an example of an issue/recommendation generated by the GIGAS project in a similar context.

9 Annexes

9.1 Annex 1 Use Case Template

Here follows a template to be used for use case compilation

- Overview

  Short introduction-overview of the use case

- Interoperability purpose

  Describe the interoperability aspect or goal addressed by the use case.

- Actors, external actors and interfaces

  Describe the list of actors (systems under analysis) involved in the use case, including any external actor or interface involved in the interactions and providing inputs or receiving outputs.

- Initial Status and Pre-requisites

  Describe the initial status and any relevant pre-condition or requisite to be fulfilled for the correct use case execution/evolution.

- Evolution

  Make a step by step description of the use case evolution, identifying any cause-effect relationship.

- Final Status and post conditions

  Describe the final status and any relevant post-condition or requisite to be fulfilled after the correct use case execution/evolution.

The above elements should be mandatory for the use case compilation which can be integrated by additional elements (e.g. UML notation, drawings..).

9.2 Annex 2 Example of Architectural Analysis: GEOSS

This annex contains the GEOSS section extracted from the GIGAS architecture TN [RD2] which contains additional descriptions of initiatives, projects and systems of systems using this methodology. For readability sake, the section has been reduced in size and contents. The purpose of the example is only to show the templates proposed by the methodology and which type of information shall be provided for each section. The validity of the contents of the example is out of the purpose of this document, for any issue please refer to GEOSS official documents.

9.2.1 Enterprise Viewpoint

9.2.1.1 Summary Table

Aspect	**Description**
Context	GEOSS is an intergovernmental programme, coordinated by Group on Earth Observations (GEO)
Start and End Date	2005 – 2015
Home Page	http://www.earthobservations.org
Summary	In June 2009 79 countries and 56 organisations participate in the GEOSS programme. GEOSS aims to integrate Earth Observation systems into a global system that can be applied to various areas of environmental science and management. GEOSS is composed of a variety of systems including those for data collection, processing, discovery and dissemination. Currently the GEOSS programme is focussing on the following nine societal benefit areas (SBA): • Reduction and Prevention of Disasters • Human Health and Epidemiology • Energy Management • Climate Change • Water Management • Weather Forecasting • Ecosystems • Agriculture • Biodiversity
Reference to architecture specification	GEOSS Architecture Implementation Pilot (AIP) Phase 2: IOC Augmentation: Version 20080626, accessible at http://portal.opengeospatial.org/files/?artifact_id=28934
Source of Requirements	GEO member countries and participating organisations.
Business rules (model),	**Interoperability Arrangements** ensure that the heterogeneous systems within GEOSS can communicate and interoperate. Data, information and service providers within GEOSS are guided by technical specifications for collecting, processing, storing, and disseminating shared data, metadata, and products. Interoperability arrangements in GEOSS are based on open standards, with preference to formal international standards. Within the architecture, Interoperability arrangements are registered in the GEOSS Standards and Interoperability

	Registry, after assessment by SIF.
Security rules	Access control mechanisms as implemented by each service provider. For example, access to EO-1 and SPOT imagery is controlled by the respective service providers.
Authority rules for privileges and permissions	Each service provider manages privileges and permissions to the resources they provide.
Resource usage rules	Users of resources are expected to abide by rules set by the service provider (for example, copyright and intellectual property)
Transfer rules,	GEO Task DA-06-01, as the International Council for Science (ICSU), has drafted a White Paper that provides an overview of international data sharing laws, principles, and policies. The white paper, which shall be presented at the 5th GEO Plenary meeting in Beijing in November 2008, recommends a draft set of implementation guidelines for the GEOSS Data Sharing Principles as outlined in the GEOSS 10-Year Implementation Plan.
Domain rules	Consortium coordinated by the Group on Earth Observations (GEO)
Important use cases	Practical use cases were described in the GEOSS Common Infrastructure and the Core Architecture Implementation Report. A generic series of use cases encompassing these practical uses cases have been designed in considering different actors (see next paragraph) • The GEO Web Portal allows service providers to register components and services. • A user is able to discover contributed services or components through the GEO Web Portal • The GEO Web Portal accesses the GEOSS Component and Service Registry to retrieve metadata about contributed EO and related services. • The GEOSS Component and Service Registry references interoperability arrangements registered in the GEOSS Standards and Interoperability Registry. • The GEO Web Portal links to GEONETCast and external community resources. • The Clearinghouse is routinely updated with contents of the Service Registry. • The GEO Web Portal, Community portals and other clients search the Clearinghouse through a catalogue service interface at a frequency dependent upon user requests The Clearinghouse is searched through a combination of 1) harvested metadata held in a local cache and 2) distributed searches to remote catalogues at the time of the users search

Table 3: Enterprise Viewpoint of GEOSS

9.2.1.2 High Level Requirements

The following requirements for the GEOSS clearinghouse were recommended to be mandatory in the Core Architecture Implementation Report:

- Shall provide a catalog service interface conformant with OGC CSW 2.0.2.
- Shall provide catalog client interfaces conformant with OGC CSW, ISO 23950.
- Shall provide a registry for the GEOSS Community Catalog Service metadata and others.

- Shall have a CSW interface to Service registries hosted at the GEO Secretariat.
- The clearinghouse shall be available at least 99% of the time, i.e., approximately 7 hours of down time a month.
- Shall be hosted on a computer hosted at the GEO Secretariat which shall provide access to the Internet.
- Maintenance of the content of Clearinghouse registers shall be performed by the GEO Secretariat.
- Geo Secretariat to host the register with instances from the contributing organization.
- Maintenance of the software of Clearinghouse shall be performed by the contributing organization.

TBC with common requirements and requirements on single GCI components

9.2.1.3 Context

GEOSS is a 10 year global programme that aims to provide to the broad environmental science and user community decision-support tools and aid the monitoring, analysis and modelling of various environmental phenomena through the integration of existing and future sources of earth observation information. This document presents the enterprise, information, engineering, computational and technology viewpoints of the GEOSS Architecture.

TBC with other descriptions and diagrams describing the GEOSS context.

9.2.1.4 Use Cases

TBC List of Use Cases and actors following template in annex1

9.2.2 Information Viewpoint

Aspect	**Description**
Model name	Observation & Measurements (O&M) model
Category	basic model
Reference to specification	See standard reference
Standard reference	OGC Document 07-022r1, October 2007
Description	Describes a framework and encoding for measurements and observations. The aim is to define a number of terms used for measurements, and the relationships between them. It discusses observation, measurement, result, procedure, feature of interest, observed property, property type, coverage and related terms,
Format	UML, XML
Comment	Model is required specifically for the Sensor Observation Service and related components of an OGC Sensor Web Enablement capability, and also for general support for OGC compliant systems dealing in technical measurements in science and engineering.

Table 4: OGC Observation and Measurement Model

TBC with one table for each data model as in the previous example

9.2.3 Service Viewpoint

9.2.3.1 Service Metamodel

Aspect	Description
Service meta-model	Reference Topic 12 - The OpenGIS Service Architecture 4.3, document 02-112 , (this is identical to ISO 19119, Actually derived from ISO 19119) Referenced in Section 4.2.4 of Annex B of the AIP-2 CFP
Service Taxonomy	Classification of geographic services: • Geographic human interaction services • Geographic model/information management services • Geographic workflow/task management services • Geographic processing services • Geographic processing services – spatial • Geographic processing services – thematic • Geographic processing services – temporal • Geographic processing services – metadata • Geographic communication services • Geographic system management services

Table 5: Service meta-model and taxonomy

9.2.3.2 List of services

Aspect	Description
Service name	Catalogue Service
Geographic Service Category	Geographic model/information management services
Project Service Category	None (project specific)
Reference to specification	Annex B of GEOSS AIP-2 CFP
Standard reference	OGC Document 07-006r1 OpenGIS Catalogue Service Implementation Specification
Description	Catalogue services support the publishing and searching of collections of metadata relating to datasets, services, and other information resources. A user or application is able to query a catalogue service and be presented with metadata describing resource characteristics. Catalogue services are the principal resource discovery tools within a spatial data community. The specification allows for bindings using CORBA, Z39.50 and HTTP. The Z39.50 binding is based on ISO 23950. The HTTP binding of the Catalogue service specification is also known as the Catalogue Service for the Web (CSW).
Format	XML, Z39.50
Comment	Various application profiles of CSW have been published, the following are those identified in the AIP-2 CFP as relevant to GEOSS:

Aspect	Description
	• Earth Observation Application Profile of CSW • ISO Metadata Application Profile of CSW • ebRIM Application Profile of CSW • BASIC package • Cataloguing for ISO Metadata (CIM)

Table 6: OGC Catalogue Service

TBC with one table for each service as in the previous example

9.2.4 Engineering Viewpoint

GEOSS is made up of components and the components expose services. A component represents a modular part of a system that encapsulates its contents and whose manifestation is replaceable within its environment. Components offer business functions as services. A component is modelled throughout the development life cycle and successively refined into deployment and run-time. Conceptually, component types are design concepts that encapsulate information objects and provide services on the information through interfaces. Component instances are developments that have been deployed and are accessible at a network address.

9.2.4.1 Component Types

The following are GEOSS component types:

- Main GEO Web site: Earthobservations.org
- GEO web portals: A single point of access to information, internal or external to GEOSS, relevant to all SBAs and is of interest to various types of users
- GEOSS Registry: Component and Service Registry (CSR), Standards and Interoperability Registry (SIR), GEOSS Best Practices Wiki, GEOSS User Requirements Registry
- GEOSS Clearinghouse : Provides search access to high-level metadata from all catalogs registered in the CSR through remote harvest of metadata or provision of distributed search. Indexes all CSR entries
- *TBC with other GEOSS components.*

9.2.4.2 Distributed Computing Environment

Aspect	Description
Platform name	"W3C Web Services Platform" following the Web Service infrastructure as defined by the W3C specifications
Reference Model	W3C Web Services Architecture
Interface Language	Web Service Description Language (WSDL), Version 1.1

Execution Context	The execution context of the W3C Web Services Platform is defined by the following properties: Transport Protocol and Message Format: SOAP 1.2 HTTP binding as defined in SOAP Part 1: Message Framework, Version 1.2 and Hypertext Transfer Protocol (HTTP), Version 1.1. The message style that shall be used is document/literal non-wrapped since it is the most widely accepted and interoperable message style. Security Session Information: The transport of session information may be accomplished by using platform specific mechanisms, for example the inclusion of a session key in the SOAP header. Encryption: Optional encryption of SOAP messages shall be accomplished by Web Services Security: 4 SOAP Message Security 1.1.
Schema Language	Extensible Markup Language (XML) 1.0
Schema Mapping	ISO 19136 for GML

Table 7: W3C Web Service Platform

TBC with one table for each platform (e.g. OGC Web Services platform) as in the previous example

9.2.4.3 Engineering Policies

This section describes use cases conducted in GEOSS AIP-2. Please note that sequence diagrams of these use cases are not available, however, the Basic Flow section of the table presents the sequence of steps in detail.

9.2.4.3.1 Resource Discovery

This use case describes the conditions and steps for portals and application clients to support the GEOSS user in searching for resources of interest via the GEOSS Clearinghouses or Community Catalogs. This use case is a pre-condition to the Present Reachable Services and Alerts use case.

Overview	
Title	Search for Resources via GEOSS Clearinghouse(s) or Community Catalog(s)
Description	This use case describes the conditions and steps for portals and application clients to support the GEOSS user in searching for resources of interest via the GEOSS Clearinghouse(s) or Community Catalog(s).
Actors and Interfaces	• GEOSS User • Client Application (GEO Portal, Community Portal, Desktop Application, Portlet, etc) • GEOSS Clearinghouse • Community Catalog
Initial Status and Preconditions	GEOSS User is looking for information of value to task at hand Client Application has been developed and is available for use

	Resources' metadata has been successfully harvested in GEOSS Clearinghouses (either directly or via registration in a Community Catalog)
Basic Flow	
Step 1: Client Application requests capabilities of catalogs of interest (GEOSS Clearinghouse and/or Community Catalogs) to determine the protocol needed to search for resources (e.g CSW 2.0.2 or Z39.50) and the queryable elements of each as needed. Alternatively, the Client Application knows a-priori the protocol needed to interact with catalog(s)/clearinghouse(s) of interest **Step 2:** Client Application presents GEOSS User with search criteria based on queryable properties of selected catalogs - Simple keyword search and area of interest/bbox search - Advanced search parameters such as organization, catalogs to be searched, societal benefit areas, resource type, etc - More specific earth-observation criteria such as sensor row/path, collection, subsetting/ordering and/or delivery mechanisms, etc - Value-added and/or domain/community specific search capabilities such as thesaurus matching, cluster matching, etc **Step 3:** Based on user selections, Client Application constructs query to each selected catalog and the ResultSet is returned and presented to the user with application-specific options (such as total number of results, basic information about each result, grouping of results, etc) **Step 4:** GEOSS User selects resources of interest for evaluation and/or use.	
Post Condition	
The Client Application has retrieved the necessary metadata to present the GEOSS User with information on discovered resources matching the search criteria for further evaluation and/or use.	

Table 8: Resource Discovery

9.2.4.3.2 Service Monitoring

This use case describes the conditions and steps to interact with a Service Instance within GEOSS. This use case can be specialized to support a variety of GEOSS services and resources such as Sensor Planning Service, Ordering Service, Models, Sensor Observation Service, WCS over netCDF, WMS Cascading, WFS Simple, CAP Alerts atompub Service, etc.

TBC with descriptions of each use case using template in annex.1

9.2.4.3.3 Access Control

The GEOSS Implementation Plan states that

"The societal benefits of Earth observations cannot be achieved without data sharing.
The following are GEOSS data sharing principles:

- *There will be full and open exchange of data, metadata, and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation.*
- *All shared data, metadata, and products will be made available with minimum time delay and at minimum cost.*
- *All shared data, metadata, and products free of charge or no more than cost of reproduction will be encouraged for research and education.*

Use of data or products does not necessarily imply agreement with or endorsement of the purpose behind the gathering of such data."

Based on the requirement in the implementation plan, it can be expected that GEOSS access control will primarily be for authentication of users. However,the use of OGC web services within GEOSS implies that OGC GeoRM (formerly GeoDRM) will play a key role in GEOSS access control as it develops.

9.2.4.3.4 Development Policies

The GEOSS Architecture Implementation Pilot (AIP) develops and deploys new process and infrastructure components for the GEOSS Common Infrastructure and the broader GEOSS architecture. AIP is a core task (GEO Task AR-09-01b) of the GEO Architecture and Data Committee. Results of the AIP are transitioned to GEO Task AR-09-01a and the GEOSS Common Infrastructure (GCI). The OGC coordinates the AIP. Progress of AIP development is listed at http://www.ogcnetwork.net/AIpilot

9.2.4.4 Implementation Architecture

Services can be classified into client, business process and access tiers. Client tier services provide the user interface of the system; the services include the GEO web site, GEOSS Web Portal, various community portals and client applications. The business process tier provides the computational and management functionality of the system; the services include the GEOSS registries, clearinghouse, alert servers, processing servers, portrayal servers, workflow management servers and other services. The access tier offers various data acquisition and dissemination services; for example GEONETCast, product access services, sensor web services, model access services and others. The following figure depicts these tiers.

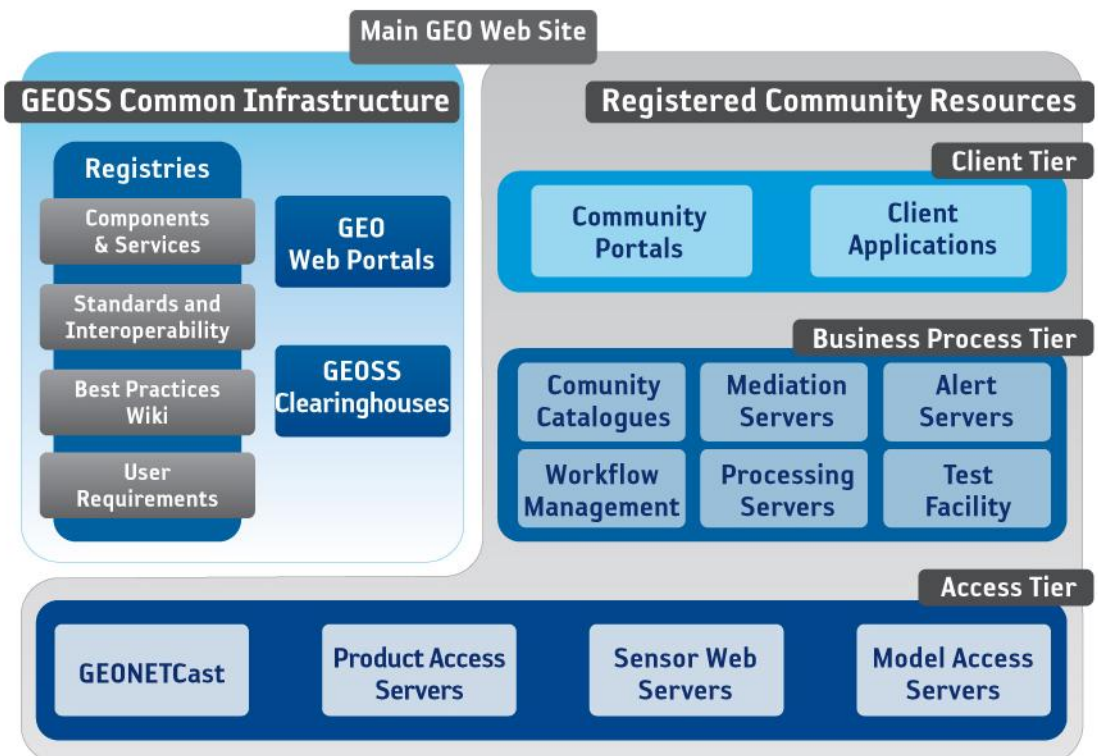

Figure 3 GEOSS Tiers

Collectively all these services form the GEOSS Common Infrastructure (GCI). Within the GCI, the web portal, registry and clearinghouse are the principal components for resource discovery. The web portal is the main application for accessing GEOSS services. The clearinghouse provides search capability across a distributed network of catalogue services. The registry publishes metadata describing components and services registered in GEOSS.

An instantiation of the above architecture is being deployed under the Heterogeneous Missions Accessibility [RD5] initiative of the European Space Agency as shown on the next figure. The Community Clients are the main applications for accessing the EO services. The EO Community Clearinghouse accessible from the GEO Web Portal provides search capability across a distributed network of catalogue services. The EO Community Service and Collection catalogue publishes ISO metadata describing Community resources e.g. EO dataset series (i.e. collections) and services registered and their interrelationships. Types of service registered include catalogues, ordering services, sensor planning services and Web mapping services. In addition, conformance test capabilities are available based on the OGC CTL language and the TEAM test engine.

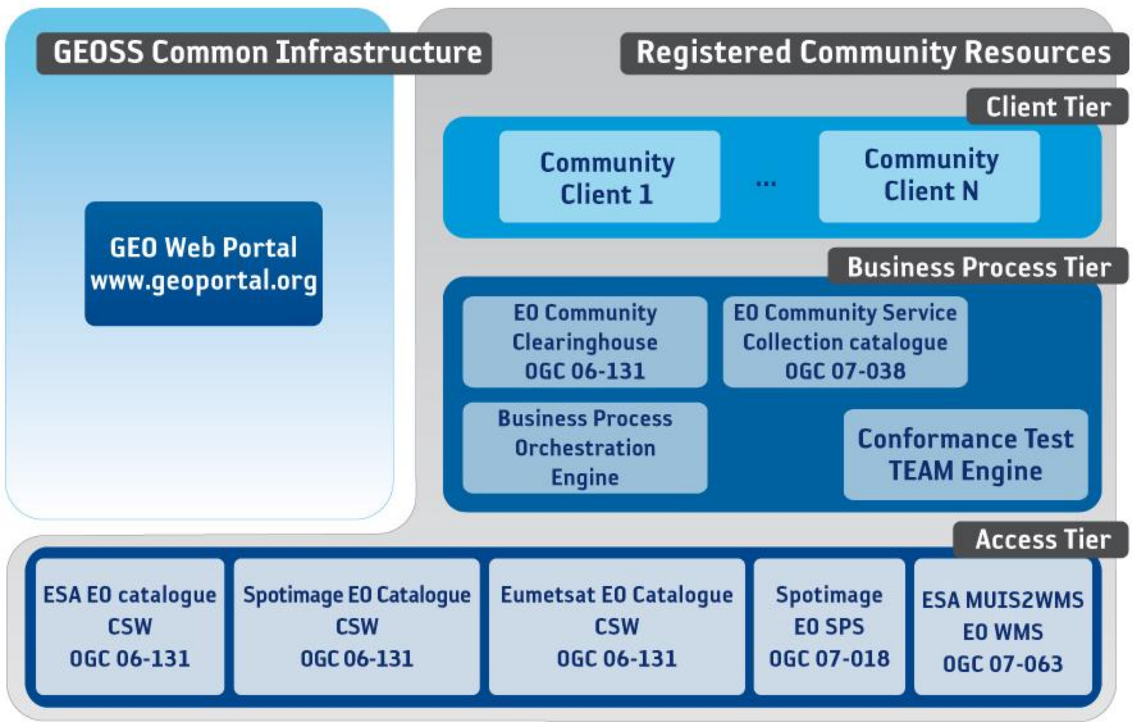

Figure 4 Example of GEOSS Tiers Instantiation for the European Union

9.2.5 Technology Viewpoint

The GEOSS Registry provides a catalogue of all registered components and services. The following requirements apply to technologies contributed to GEOSS:

- Upon registering a service, a service provider must specify the length of time for which the service will be offered (preferably 'unlimited').
- Experimental services will be registered and exempt from the level of service requirements.
- Services are expected to be available at least 99% of the time, except when otherwise required by the nature of the service. This allows for approximately 7 hours of down time a month. Adequate network service must be utilized in order to provide this level of availability.

- Non-functioning components of the Network will diminish the operational and marketing value of the Network in general for all participating organizations. Therefore, GEO may remove a listed server from the registry

9.2.5.1 Component Implementation

It should be noted that GEOSS is a system of contributed systems, components and services. Therefore, contributors have adopted a variety of technologies for implementing the components contributed to GEOSS. In this sub-section we have selected some of the components and instances that have been used in the AIP and associated tasks.

- Community portals: A community-focused portal (website) that provides a human user interface to identified content. Some of the component instances used include ESRI GIS Portal toolkit, Compusult, ESA/FAO portal products.

- Client applications: Application hosted on users computer to access remote services and provide manipulation of the data in the client application. Clients may be specific to a user community or may be more generic geospatial data applications. Some of the clients that have been used to interact with GEOSS components during AIP-2 included web browsers (Internet Explorer, Mozilla Firefox), UDig (used as WPS client), Google Earth and ERDAS TITAN.

- Community catalogues: Collection of community-organized information descriptions (metadata) exposed through standard catalog service interfaces. Example component instances used include catalogue services(CSW) bundled with ESRI GIS Portal toolkit and another developed by George Mason University.

- Workflow management: Encapsulates an engine capable of managing workflows, services, activities, and workflow execution instances. An example instance is BPELPower developed by George Mason University. GMU BPELPower BPEL engine is a generic BPEL workflow execution engine. Another workflow engine is Oracle BPEL Process Manager used by ESA Service Support Environment (SSE).

- Processing services: Components that accepts requests to process data using an algorithm hosted in the component. The data is accessed from a remote service. The processing services used in AIP-2 were offered through instances of the 52North WPS.

- GEONETCast: Global network of satellite-based data dissemination systems to distribute data via broadcast. The GEONETCast multicasting allows different datasets or EO products to be transmitted in parallel from satellites or in-situ sensors. Access to data is controlled and targeted to specific groups of users through a key access capability. The multicast capability uses a global network of communications satellites that includes direct-to-home (DTH) telecommunication satellites and Digital Video Broadcast (DVB). GEONETCast is describes in detail by Wolf L. and Williams M. (2008) "GEONETCast—Delivering Environmental Data to Users Worldwide" IEEE Systems Journal, pp. 401-405, 2(3) DOI 10.1109/JSYST.2008.925978

9.2.5.2 Run-time Environment

There are no requirements in GEOSS for specific run-time requirements. Components and Services within GEOSS are implemented in a variety of run-time environments.

9.2.5.3 Deployed Service Instances and Networks

The following are lists of Components and Services currently registered in the GEOSS Registry.

The following table is a list of components catalogued in the GEOSS Registry exported on September 9th 2009.

1.	52°North SOS Client	Details
2.	AIRNow Gateway Web Service	Details
	TBC with list of other components	

Table 9 Extract of the Components Registered in GEOSS by September 9th 2009

The following table is a list of services catalogued in the GEOSS Registry. The list was exported on September 09th 2009.

1.	Water Survey of Canada WMS Service	Details
2.	VASDI greenland wms_n_baggrund service	Details
	TBC with list of other services	

Table 10 Extract of the Services Registered in GEOSS by September 9th 2009

9.2.5.4 Standardisation Process

During service registration, service providers enter references to interoperability arrangements adopted by their contributed services and components. Interoperability arrangements can include international standards such as those of the OGC, IEEE or W3C; but may also be special arrangements based on application-specific business rules.

If the standard is not already a registered specification, it is assessed by the Standards and Interoperability Forum (SIF) then registered. The main purpose of the SIF is to ensure that GEOSS components can interoperate through one of the registered standards or other interoperability arrangements. The SIF facilitated interoperability through technical analysis, advocacy, education and the provision of impartial advice on issues regarding standardisation and interoperability within GEOSS. The following figure illustrates the role of the SIF.

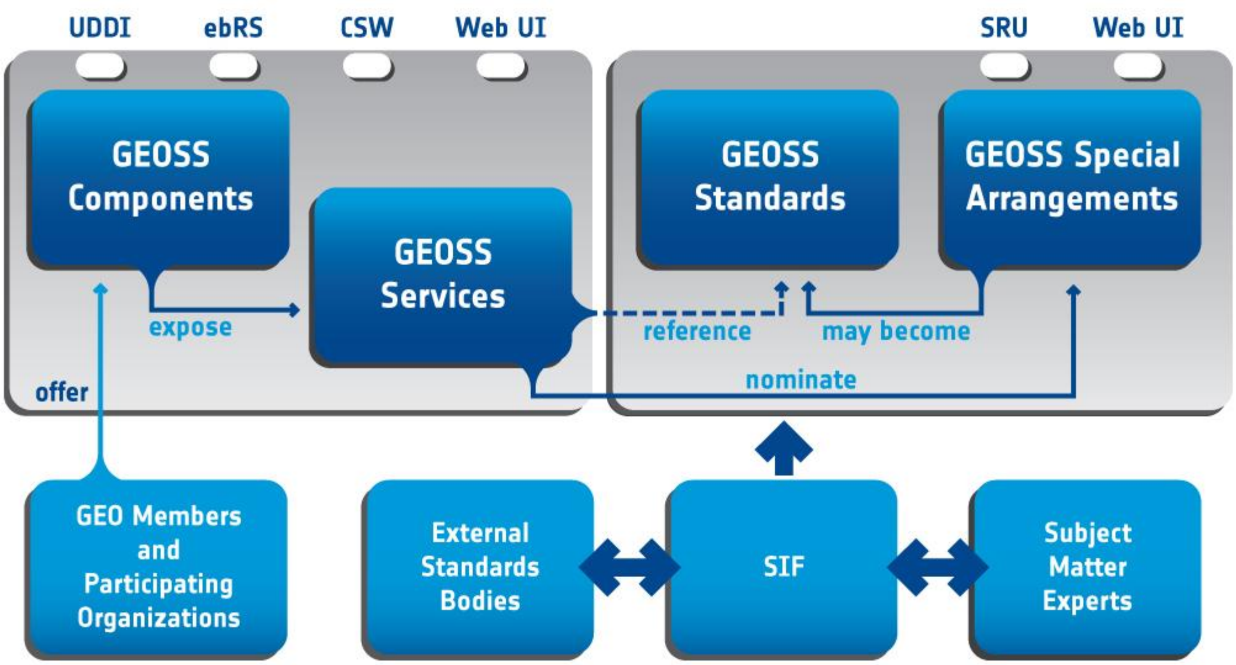

Figure 5 SIF Role

All registered standards are entered in the Standards and Interoperability Registry. The architectural role of the Standards and Interoperability Registry is depicted in the GEOSS Common Infrastructure described in the GEOSS Engineering Viewpoint sub-section of this chapter.

The SIF promotes to form Regional Teams to have true global representation in supporting GEOSS interoperability. A SIF European Team was promoted (see http://www.thegigasforum.eu/sif/). In this framework, the purpose of having a European Regional Team is to increase efficiency in carrying out the work of the SIF, addressing issues such as:

- bring local knowledge and reach out multi-disciplinary and regional science Communities;

- provide knowledge and experts about regional standard and interoperability arrangements;
- support the SIF to complete the tasks submitted by Communities.

The SIF European Regional team will

- identify subject matter experts representing each (or most) of the Societal Benefit Areas of GEOSS in Europe.
- facilitate the registration of European standards and interoperability best practices (e.g. special arrangements).
- be prepared to review standards and special arrangements submitted for entry into the standards registry.
- help reach out to scientific Communities in Europe, as far as GEOSS is concerned.

URL for accessing the present GEOSS deployed services is http://geossregistries.info/

9.3 Annex 3 Requirements on Requirements

The following requirements define a set of basic rules on how to write requirements. The rules are derived from ECSS E-10 6C [RD7] which can be used as a reference for writing requirements.

- Each requirement shall be separately stated.
- A requirement shall be self-contained.
- Each requirement shall consist of a single sentence with “shall” or “should”,

  Note: notes like this can be used to clarify the sense of the requirement
- The verbal form “shall” shall be used whenever a provision is a requirement.
- The verbal form “should” shall be used whenever a provision is a recommendation.
- The verbal form “may” shall be used whenever a provision is a permission.
- The verbal form “can” shall be used to indicate possibility or capability.
- Requirements should be stated in performance or “what-is-necessary” terms, as opposed to telling a supplier “how to” perform a task, unless the exact steps in performance of the task are essential to ensure the proper functioning of the product.
- Requirements should be expressed in a positive way, as a complete sentence (verb and noun).
- The entity responsible of the technical requirement shall be identified.
- All technical requirements shall be backwards-traceable and forwards-traceable.
- Any detected ambiguity in a requirement shall be removed.
- Each requirement shall be unique.
- Each requirement shall have a unique identifier
- A proposed syntax for the requirement identifier should be

  <project-acronym>-XXX-YYY-NNN

  Where
  - <project-acronym> is something like GEO
  - XXX is an identifier of the topic/working group, e.g. CAT for “”Catalogue”

    - YYY is a 2nd level acronym e.g. FUN for functional, GEN for general, OPE for operational..
    - NNN is a counter, it is suggested to start numbering requirements with a step of 10 (e.g. 010, 020 etc, in order to be able to insert new requirements later (e.g 011, 012 etc.)
- The requirements should be grouped by type or in accordance with the different situations of the product or system life cycle in regard of the needs, the environmental conditions and the constraints.
- The requirements shall be unambiguous and not in conflict with the other associated requirements in contractual documentation.
- A priority should be identified for each requirement.
- Each (performance) requirement shall be described in quantifiable terms.
- Each (performance) requirement should include an attribute that defines the method used to determine the required performance.
- A requirement shall be verifiable using one or more approved verification methods.
- The following items (and similar ones) should not be used in a requirement
    - “and/or”,
    - “etc”,
    - “goal”,
    - “shall be included but not limited to”,
    - “relevant”, “necessary”, “appropriate”,
    - “as far as possible”,
    - “optimize”, “minimize”, “maximize”,
    - “typical”,
    - “rapid”, “quick”
    - “user-friendly”,
    - “easy”,
    - “sufficient”, “enough”,
    - “suitable”, “satisfactory”, “adequate”,
    - “first rate”,

- “best possible”,
- “great”, “small”, “large”,
- “state of the art”.

9.4 Annex 4 Example of Draft Issue/Recommendation

Summary

"It is recommended

- *to GIGAS to define a sustainable model for a permanent test environment ('persistent research test-bed'),*
- *to initiatives and organizations like INSPIRE/GEOSS/GMES/OGC/AGILE/EuroSDR and existing and future research projects to design, develop and test new types of interoperable geospatial services and interfaces in the context of this testbed, and*
- *to the EC/EU and related organisations to foster research by offering this sandbox environment.*

Classification

Category

Interoperability tools

Identifier

REC-IT-001 Persistent Testbed

Type of recommended activity

Business model

Organisations addressed

GIGAS (as the one to start the development) and INSPIRE Consolidation Team, GEOSS ,GMES, OGC, AGILE, EuroSDR, ISO/TC-211, CEN TC287

Additional information

Context

It is recommended to define a sustainable model for a persistent test-bed so that uptake of standards by industry and institutions is eased.The envisaged testbed is assumed to provide

- *An open, permanent infrastructure in which organisations or external projects can integrate their (compliant) services.*
- *A permanent test environment to design, develop and test new services and service interfaces and to foster related research by to offering a sandbox for not yet established service types.*
- *Optionally conformance test tools (as for example CITE).*
- *A set of tools supporting the target interfaces (ideally offered as freely available open source tools).*

Full recommendation text

It is recommended

- *to GIGAS to define a sustainable model for a permanent test environment ('persistent research test-bed'),*
- *to initiatives and organizations like INSPIRE/GEOSS/GMES/OGC/AGILE/EuroSDR and existing and future research projects to design, develop and test new types of interoperable geospatial services and interfaces in the context of this testbed, and*

- *to the EC/EU and related organisations to foster research by offering this sandbox environment.*

Rationale

Although multiple and diverse testing activities exist among the initiatives and standardisation organisations, none of them provides a sustainable and persistent environment to test and develop new standards and data specifications. Each testing activity has to set up an own environment. This includes redundant time and effort from scratch, because in most cases, the same kinds of data and processing services are used. A persistent testbed could help to minimize these efforts by offering such services for a sustainable time period. More time can be spent for solving the real research problem. Besides, the services could be used to reliably serve teaching purposes and the various research outcomes can be offered for a longer time period instead of vanishing after a project is finished. This would improve the work of the whole geospatial interoperability research community in Europe.

Dependencies

Main discussion points

To enable the persistent characteristics of the testbed, the maintenance of the offered services and the according management activities are a critical issue. Although this requires only a modicum of money and manpower, the funding has to be assured over years.

Further background information

The development of the business model for the testbed is carried out in strong cooperation with the AGILE/EuroSDR/OGC Persistent Testbed for Research and Teaching in Europe (PTB). A lot of information can be acquired from their website at http://plone.itc.nl/gitestbed.

Roadmap

The business model for the Persistent Testbed is tackled by the deliverable D3.5 "GIGAS Persistent Testbed Business Model". Details can be found there as soon it is published (first draft in the end of September 2009).

Follow-up

The business model for the Persistent Testbed is tackled by the deliverable D3.5 "GIGAS Persistent Testbed Business Model". Details can be found there as soon it is published (first draft in the end of September 2009)

On-line discussion

You can add your own thoughts and remarks about this topic in the GIGAS comment section.

If you are not yet registered yet, you can do so at the GIGAS discussion board.

9.5 Annex 5 RM-ODP in GEO Architecture Implementation Pilot

The GEO Architecture Implementation Pilot (AIP) is using the RM-ODP approach for its design. **This approach has the advantage that the proposed methodology can be used as a tool to identify gaps and areas of convergence in parallel to the AIP design.**

The AIP is developing RM-ODP viewpoints using UML in accordance with the following principles:

1. "Creating explicit models of a system's design is the step leading from art to practice" is the approach taken by Christopher Alexander's Notes on the Synthesis of Form, and Eberhardt Rechtin' System Architecting." The principal is that explicit models are needed for the community of interest for the system to inspect and critique in order to have an optimum development practice.
2. "Architecture practice requires description of the system from multiple viewpoints" is consistent with almost all International standards for architecture which consistently require a set of viewpoints, e.g., IEEE 1220, ISO/IEC 10746, ISO/IEC 19793
3. "System-of-system development requires iteration of design synthesis with existing implementations". There is no "blank sheet" starting point for system development in a system of systems. The models can begin with abstracting the key design aspects from the deployed system. Optimization is achieved through iterations of deployment analysis, design refinement and refinement of the deployments.

The GEO AIP makes use of ISO/IEC 19793. The following table summarizes the content of the viewpoints used in AIP:

Viewpoint Name	GEO AIP Viewpoint Summary	GEO AIP Viewpoint Contents
Enterprise	Scenarios, system purpose, users, policies,	Community of Practice Scenarios Community Objectives, Actors, Pre-Conditions, Events, Post Conditions, Enterprise Model Context Diagram: UML diagram showing GEOSS and the externals – no internal structure Enterprise Specification: UML class diagram of Enterprise Objects Activity Diagram: UML activity diagram with swimlanes of Scenario Events (functional and data flow) Process Diagram (optional): UML sequence diagram of Scenario Events
Information	Abstract information concepts; Concrete encodings	UML class diagram for Information Types: ERD SBA specific classes: e.g., flooded areas, GEOSS wide data types: Global data sets, Framework data types in CFP Cross-cutting technology classes: e.g., geospatial features Focus on basetypes/classes and too a lesser extent individual attributes
Comp	Service oriented	Use Case from technology point of view including these elments: Actors and Interfaces,

Viewpoint Name	**GEO AIP Viewpoint Summary**	**GEO AIP Viewpoint Contents**
	architecture; Use cases	Initial Status and Preconditions, Evolution, Post Condition SOA concepts: publish-find-bind and Service definitions Use Cases of two types are define: • Generalized Use Cases modeled as an activity diagram or sequence diagram • Specialized Use Cases for the Community of Practice Scenarios Activity diagram or sequence diagram Mapping to Enterprise Activity Diagrams as activity hierarchy
Engineering	Component types; Communication media	Component Types UML Component diagram Mapping from generalized use cases to the component types Mapping services to component types
Technolo gy	Component instances with network addresses	Component Instances identified by referring to the GEOSS Component and Service Registry Representative Deployment diagrams Not aiming to completely describe all deployed components in the Tech View

Table 11 Contents of the RM-ODP Viewpoints for GEOSS AIP