Architecture Implementation Pilot
Call for Participation (CFP)

CFP Issuance Date: 13 April 2007

Response Due Date: 11 May 2007

Pilot Kickoff Meeting: 5-6 June 2007

Preface

This Call for Participation (CFP) seeks participants in a coordinated Geospatial Architecture Implementation Pilot. A Pilot is a collaborative effort that applies open standards for interoperability to achieve user objectives in an environment representative of operational use. Outcomes include best-practices and interoperability arrangements suitable for an operational capability. An aim of the Pilot is to reach consensus on architectural elements that initiatives supporting geospatial information systems can carry forward into operations, thereby increasing the overall level of interoperability.

This CFP seeks proposals from organizations involved with Earth Observation systems to:

- Identify components with <u>services</u>, e.g., portals, catalogs and other services;

- Participate in confirming the <u>interoperability</u> of those identified services using standards and interoperability arrangements as identified in the preliminary architecture of this CFP; and,

- Participate in the collaborative development of societal benefit <u>scenarios</u> to guide testing and demonstrations of the identified interoperable services.

Organizations responding to the CFP should plan to fully participate in the Pilot development activities beginning with the Kickoff Workshop.

The CFP was initiated to solicit response for the GEOSS Architecture Implementation Pilot identified by the GEOSS Architecture and Data Committee as an essential step in moving forward to an operational capability. The Pilot aims to incorporate contributed components consistent with the GEOSS Architecture - using a GEO Web Portal and a GEOSS Clearinghouse search facility – to access services through GEOSS Interoperability Arrangements in support of the GEO Societal Benefit Areas. The GEO Task AR-07-02 will conduct this pilot consistent with the request of the GEO Plenary.

Interest in the Geospatial Pilot has already been expressed by two other organizations which have offered their pilots for collaboration with GEOSS. In the interest of providing a broad assessment of capabilities, the collaboration of these pilots provides opportunities to address interoperability on a broad scale. The Pilots are:

- The Tri-Lateral Interoperability Pilot is a collaborative, open standards development, supporting collective requirements of organizations responsible for national and regional "Spatial Data Infrastructures" in Europe (INSPIRE), Canada (GeoConnections), and the U.S.A. (FGDC)

- The Federated Earth Observation Missions (FedEO) Pilot provides a broad international venue for operational prototyping and demonstration of Earth Observation (EO) requirements and protocols as defined by the European Space Agency (ESA), together with other space agencies (ASI, CNES, CSA, DLR) and users (EUSC) and other OGC members.

Geospatial Architecture Implementation Pilot
Call for Participation (CFP)

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Geospatial Architecture Implementation Pilot
Call for Participation (CFP)

1   Introduction

1.1 Purpose

This Call for Participation (CFP) seeks organizations to participate in an Architecture Implementation Pilot.

This CFP was initiated to support the GEO Task AR-07-02, which addresses the need for a Clearinghouse, Portal and supporting capabilities. Since the successful Pilot will address interoperability and user support in the broadest manner, broad participation is encouraged in order to achieve the Pilot's objectives on a voluntary basis. This benefits both the participant organizations and the GEO Architecture development.

Two pilots have indicated their interest in collaboration. These are:

- Tri-Lateral Agreement Pilot

- Federated Earth Observation Pilot

All organizations interested in participating in the Pilots shall respond with a proposal. Instructions for submitting proposals are provided in Section 3.

1.2 The CFP Process

The CFP Process is part of a Development Process for Interoperability Initiatives. Previous steps in the process include Requests for Information (RFIs) that determined the interest and state of readiness for conducting the Pilot Execution Phase. The results of the RFIs and other inputs were used as inputs for the draft architecture of the Pilot. The architecture will be refined during the Pilot Execution Phase.   This CFP seeks participants in the Execution Phase.

The Pilot Development Process is defined in Annex A of this CFP.

The Pilot CFP Architecture is defined in Annex B of this CFP.

The Process for the Pilot has been defined using the Open Geospatial Consortium's (OGC's) Interoperability Program process. The OGC Interoperability Program is a global, collaborative prototyping program designed for rapid development of implementations and specifications for geospatial interoperability.

1.3 Master Schedule

The following table details the major events associated with this CFP:

CFP Issued	13 April 2007
CFP Responses Due	11 May 2007
Kickoff Meeting at ESA-ESRIN, Frascati, Italy	5-6 June 2007
Demonstration, Washington DC, USA	September 2007
EO Summit and GEO Plenary, Cape Town, South Africa	November 2007

2   Context

2.1 GEOSS Architecture Implementation Pilot

The high-level objectives of this Pilot are:

- Identify Components with <u>services</u> relevant to GEOSS Clearinghouse and GEO Web Portal, e.g., specific EO portals, catalogs, and other services;

- Participate in confirming the <u>interoperability</u> of those identified services using standards and interoperability arrangements of the GEOSS architecture; and,

- Participate in the collaborative development of societal benefit <u>scenarios</u> to guide testing and demonstrations of the identified interoperable services.

The GEOSS Architecture Implementation Pilot task aims to incorporate contributed components consistent with the GEOSS Architecture using a GEO Web Portal and a GEOSS Clearinghouse search facility to access services through GEOSS Interoperability Arrangements in support of the GEO Societal Benefit Areas.   This pilot is GEO Task AR-07-02 conducted by the GEO Architecture and Data Committee and is coordinated with the GEO Task AR-07-01 which is (1)developing interoperability and component/services registries along with (2) implementation of the Standards and Interoperability Form.

Participation in this Pilot anticipates

1) Submission of potential GEO Web Portal solutions, to be made available for free installation at multiple GEO member or participating organization locations, including, potentially at or on behalf of the GEO Secretariat.

2) Submission of potential GEOSS Clearinghouse search facility solutions, to be made available for free installation at multiple GEO member or participating

organization locations, including, potentially at or on behalf of the GEO Secretariat.

3) Registration of components and services hosted by the participating organization in the GEOSS Registry to support access by the Clearinghouse and Portal, and that to support demonstration of a set of user scenarios.

4) Participation in the development of a set of user scenarios that support the GEO Societal Benefit Areas.

5) Participation in the refinement of the initial architecture in Annex B based upon the pilot activities.

2.2 Tri-Lateral Pilot

The organizations responsible for national and regional "Spatial Data Infrastructures" in Europe (INSPIRE), Canada (GeoConnections), and the U.S. (FGDC) signed a tri-lateral arrangement document in January 2006 to formalize collaboration on applied geospatial standardization in an international context.

The Tri-Lateral Interoperability Pilot is a collaborative, open standards development, supporting collective requirements of governments with the knowledge and capabilities of academic, commercial, and non-commercial solutions providers.

Participation in this Pilot invites the contribution of standards-based services that can be catalogued and accessed to support multiple international interests. The pilot builds on existing components addressing issues of desertification, land use and land cover change, deforestation, forest fires, hydrological resources and modeling, and resulting pressures on ecosystems and biodiversity made interoperable through the GEOSS architecture to provide support to decision-makers in Africa. The CFP invites other organizations to register components relevant to such policy-relevant endeavor (e.g. related to demography, socio-economic pressures, humanitarian needs, health, and so on) so that the added value of the system of systems approach can be demonstrated through this pilot. Technical objectives of this pilot include tests of distributed access to catalogues' contents and protocols as defined in Annex B of this CFP (Section 4.3), with particular interest into OGC Catalog Service for the Web (CSW) catalogues i.e. ebRIM and ISO 19115/19119 and service registries i.e. UDDI and OASIS ebRS access. The WMS and WFS services will also be part of the Tri-Lateral Pilot.

2.3 Federated Earth Observation Pilot

The Federated Earth Observation Missions (FedEO) Pilot will provide a broad international venue for operational prototyping and demonstration of Earth Observation (EO) requirements and protocols as defined by the European Space Agency (ESA) , together with other space agencies (ASI, CNES, CSA, DLR) and users (EUSC) and by other OGC members. The FedEO Pilot will apply and refine OGC specifications relevant

to EO. The FedEO Pilot will test and validate OGC specifications in a business context, and will provide feedback regarding their ability to improve access to and application of earth observation data and services.

The FedEO Pilot will test and validate OGC specifications and profiles proposed in the context of the Heterogeneous Missions Accessibility project to improve access to and application of Earth Observation data and services.

The FedEO pilot will offer a persistent service support and protocol demonstration and testing environment based on the ESA's Service Support Environment.

The FedEO Pilot will focus on refining the following services:

- Collection and service catalogue discovery,

- Catalogue search service,

- Satellite Programming and Product Order,

- Online Data Access,

- Satellite Multicast Service,

- Orthorectification and re-projection services,

- Service Orchestration

2.4 Other GEO Activities

Collaboration with other GEO Tasks is anticipated, in particular with GEO Task AR-06-01 and its GEOSS Interoperability Process Pilot Project (IPPP)

The GEOSS Interoperability Process Pilot Project (IPPP) began in October 2006 with the aim of exercising and refining the GEOSS "process for reaching interoperability arrangements" under the auspices of the GEO Architecture and Data Committee. Using data and information components from weather, biodiversity, seismology, climate and other fields, the IPPP has developed use case scenarios that involve data interchange between two or more of these components. The IPPP is following the GEOSS component and service interface registration process and working with the Standards and Interoperability Forum to manage "special arrangements" when systems cannot interoperate via accepted (is a better word here "registered"?) GEOSS standards. As a core part of the GEOSS architecture development process, it is anticipated that responses to this CFP will incorporate the IPPP developments into their participation activities. Further information on the IPPP will be available after April 16 at the web site:

http://www.grss-ieee.org/menu.taf?menu=GEOSS&detail=architecture

2.5 Common Architectural Context

While each of the pilots has its own objectives, there is a high degree of commonality of the architecture of the pilots. An aim of the collaborative Pilot is to reach consensus on architectural elements that initiatives in support of geospatial information systems can carry forward into operations, thereby increasing the overall level of interoperability.

Participants in this initiative will implement the services identified in the architecture provided in Annex B. Other than the architecture described in Annex B, participants will have flexibility in deploying interoperable interfaces and protocols for use in the demonstrations associated with the operational context.

The architecture presented in Annex B is based on the current "mainstream" approach to service oriented architecture (SOA) and was selected to provide the best opportunity for meeting the Pilot requirements. This architecture is not intended to determine the physical system configuration, but to identify the interfaces and protocols within the current mainstream SOA. Participants are assumed to be providing any and all hardware, software, networks, personnel, etc., needed to make their services available to the Pilot.
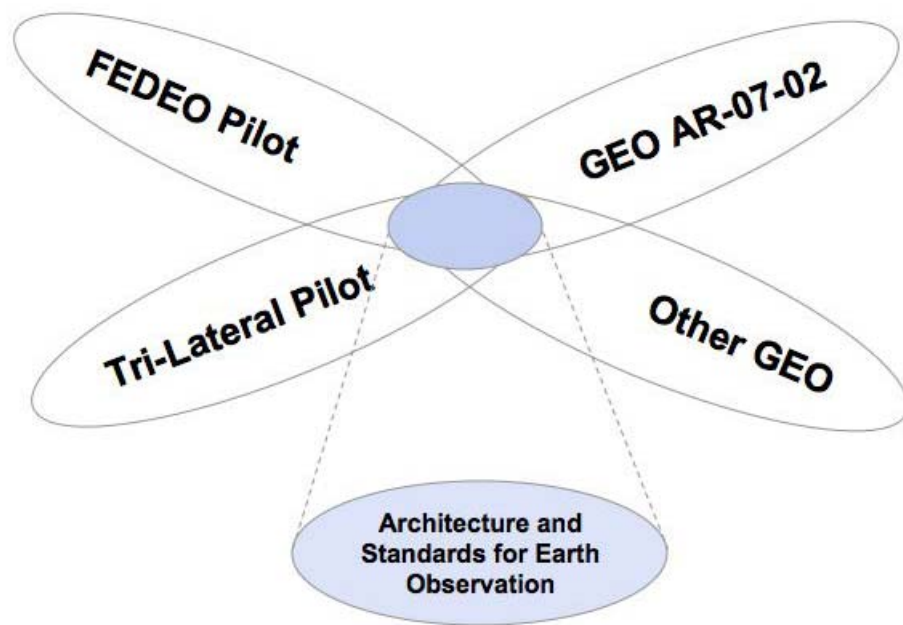

Figure 1 - Architecture for Coordinated Pilot

3   CFP Response Terms and Conditions

Documentation submitted in response to this CFP will be distributed to many organizations and may be posted on a publicly accessible web site. Responders shall not include information in their responses for which you are not authorized to distribute.

<u>Proprietary and confidential information must not be submitted under this request.</u> **It will be assumed that CFP responses do not contain confidential information.**

This CFP does not offer compensation to organizations preparing a response to the CFP. The CFP does not offer funds to any organizations for participation in the Pilot.

Submit an electronic copy of your CFP response to the OGC Technology Desk (techdesk@opengeospatial.org). Microsoft Word® 2000 for Windows, 2001 for Macintosh, or higher format is preferred; however, Portable Document Format or Rich Text Format are acceptable.

Proposals must be received no later than the date and time in Master Schedule (Section 1.3).

Questions and requests for clarification should be sent electronically to the OGC Technology Desk (techdesk@opengeospatial.org).

4   CFP Response Format and Content

4.1 Proposal Outline

The proposal should follow the following outline:

- Cover page

- Overview

- Proposed Contributions

  - Demonstration Scenario Development

  - Component and Service Contributions

  - Architecture and Interoperability Arrangement Development

- Description of Responding Organization

4.2 Cover Page

Provide the name(s) of the responding organization(s).   Teams of organizations should list the names of all organizations. It is encouraged that organizational logos are included on the cover page. .

4.3 Overview

Provide a one-page introduction to the contents of your proposal and its benefits.

4.4 Proposed Contributions

Describe your proposed contribution to the Pilot based on your desired role. Justify your approach.

4.4.1 Demonstration Scenario Development

If you are proposing to develop scenarios for the demonstrations, please include the following in your response:

- Define Scenarios that can be supported by the architecture defined in Annex B.

- Delineate aspects of the existing Annex B scenarios to which you propose to contribute.

- Provide comments on the Annex B architecture to increase the expectation that the results will support Societal Benefit Areas (SBAs).

- Describe participation and/or membership of the responding organization in SBA activities; list relevant experience for SBAs the organization is offering to participate in,

- Define plans for participating in the Pilot Activities regarding scenario development and the application of the scenarios to component integration and demonstration.

Do not assume a single participant demonstration; rather the demonstrations will show how the various components can interoperate to produce results unique to coordinated activity of the participants.

4.4.2 Component and Service Contributions

If you plan to contribute components and services, please include the following in your response:

- Descriptions of the components and services to be contributed,

- Relationship of the components and services to the architecture in Annex B. Comments to support the refinement of the Annex B architecture are encouraged,

- Examples of which Societal Benefit Areas that the components and services support, e.g., relevant data, processing capabilities and/or client applications,

- Support of open standards by the components,

- Performance capability of the components including typical traffic (hits per hour) that the components support, and

- Availability of the components for participation in the Pilot activities including persistent demonstration.

4.4.3 Architecture and Interoperability Arrangement Development

If you plan to contribute or support the refinement of the architecture and interoperability arrangements, please include the following in your response:

- Comments and contributions to the architecture in Annex B,

- Comments on the GEOSS Process for Reaching Interoperability Arrangements (produced by GEO Task AR-06-01), and specifically, plans on use of GEOSS open standards or interactions with the Standards and Interoperability Forum in making "special arrangements" for use of non-GEOSS standards.

- Describe participation and/or membership of the responding organization in standards developing organizations; list relevant experience for specific open standards,

- Plans to support refinement and elaboration of the currently defined architecture and interoperability arrangements during the Pilot activities.

4.5 Description of Responding Organization

Provide a brief description of responding organization including its relationship to the Pilot Initiatives, e.g., GEO Member or Participation Organization.

Describe the Organizations approach to supporting the Pilot including identifying the human and system resources to be assigned to participate in the Pilots.

Provide contact information for both a Programmatic Contact and for a Technical Contact. The contact person may be the same for Programmatic and Technical contacts.

Architecture Implementation Pilot
Call for Participation (CFP)
Annex A – Development Plan

CFP Issuance Date: 13 April 2007

Response Due Date: 11 May 2007

Pilots Kickoff Meeting: 5-6 June 2007

Architecture Implementation Pilot - Call for Participation Annex A – Development Plan

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Architecture Implementation Pilot - Call for Participation Annex A – Development Plan

1 Overview

This Annex to the Call for Participation (CFP) describes the development plan for the Pilot initiative.

The procedures in this annex are an application of the OGC Interoperability Program procedures for a Pilot Initiative. More information can be found here: http://www.opengeospatial.org/ogc/policies/ippp

2 Pilot development phases

A Pilot Initiative is where open standards can be "stress tested" and perfected based on real-world application and experience. While some research may be done during a pilot in terms of refining, documenting, and distributing specifications and in terms of developing prototypical software that exercises the refined specification, this research is directed at improving existing specifications rather than in creating new specifications.

The general approach to performing pilots is to go through a five-step process (Figure 1). The details of these Tasks are explained below.
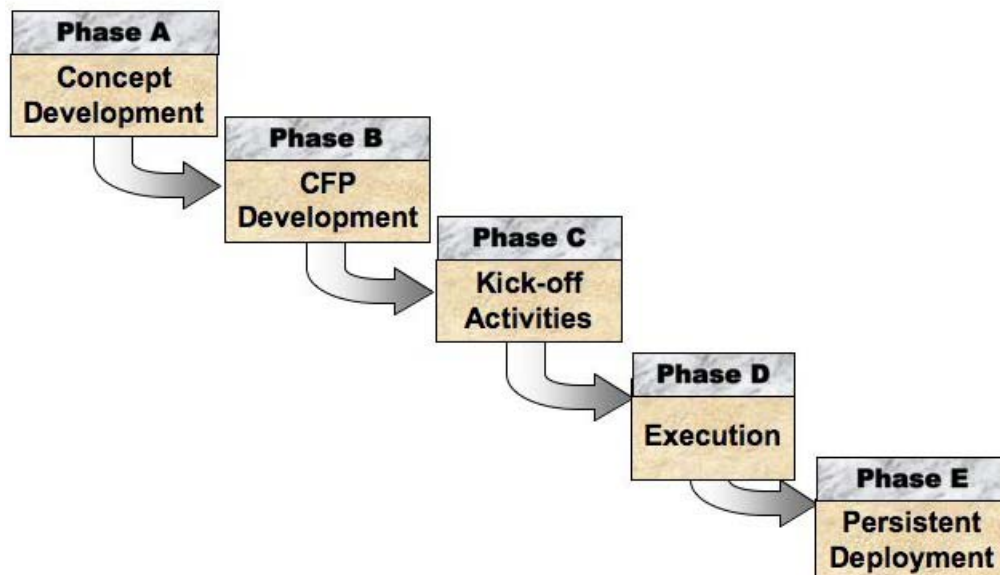

Figure 1 – Pilot Phases

2.1 Phase A: Concept development

The Concept Development phase results in an architecture, requirements and a plan sufficient to develop a Call for Participation in the Pilot Initiative.

The GEOSS ADC RFIs for Clearinghouse and Web Portal along with the GEOSS Ten-year Plan Reference Document, the GEO Work Plan and the efforts of the GEO ADC and the Task Team contributed to the concept development.

The Federated Earth Observation (FEDEO) Pilot Initiative planning has contributed to Concept Development.

The Tri-Lateral Agreement Pilot Initiative planning has contributed to Concept Development.

2.2 Phase B: CFP development

Phase B of an IP Pilot is to release a Call for Participation (CFP) and to receive and evaluate responses to this CFP.

Once a draft CFP is available, it was be presented to the GEO Task Team (AR-07-02) and Pilot Sponsors for their review and comments. Comments were addressed and incorporated by IP Team into the final version of the CFP. Once the Task Team and Sponsors agreed to the release, the CFP is announced through several communication mechanisms. The desire is that multiple will submit proposals that explain the technical contribution they intend to make, how their contribution maps to the architecture, and the contributions they will make to the initiatives..

The following guidelines are provided to organizations for proposal development:

- Annex B of this CFP is the initial baseline for the Pilot Initiative. The relationship between the content of the proposal and Annex B should be noted by the Proposing organizations. Proposals need not address the full spectrum of the architecture as outlined in Annex B. Proposals can focus on specific portions of that architecture.

- Proposing organizations should plan on performing all development work at their own facilities. These facilities should include a server (where applicable) that is accessible to other testbed participants via the Internet. TIEs will be carried out among the participants based on these Internet-accessible servers.

- Proposing organizations should be prepared to build interoperable components and thus should be prepared to cooperate with all selected development teams, regardless of whether individual proposals covered the full pilot architecture or portions of it.

- Software components developed in the initiative should either be based upon currently operational components, or should be prototypes or pre-release versions of components that the responding organization intends to deploy.

- Responding organizations must participate in the full course of interface and component development, test and integration experiments, and other essential activities throughout the initiative in order to have access to and participate in demonstration exercises.

- Proposing organizations shall respond using the outline for responses in the main body of the CFP.

Organizations should plan to send at least one technical representative to the Kickoff meeting. Dates for the Pilot events are provided in the Master Schedule (CFP Main Body)

2.3 Phase C: Kickoff activities

On receipt of the responses, the IP Team will review the responses, update the architecture and plan for the kickoff meeting.

All responding organizations should assume that their responses are accepted for participation in the Pilot unless they are notified otherwise.

The Pilot architecture, schedule, and development plan will be updated by the IP Team prior to the kickoff. The IP Team will work with the GEO Task Team and Initiative Sponsors to develop an agenda for the Kickoff Meeting.

One goal of the Pilot Kickoff meeting is to obtain consensus on the work plans for the Pilots by all stakeholders in the initiative.

The Kickoff meeting will address two development activities in the Pilot process: (1) component interface and protocol definitions, and (2) demonstration scenario development. The development activities will interact and affect each other, and the interaction will be iterative. During the Kickoff, both activities will be jump-started using the preliminary architecture and other assets that participants bring to pilot. Participants will be asked to volunteer to address any perceived shortfalls. The Initiative Manager will lead daily plenary meetings for the exchange of information.

An additional product of the Kickoff meeting will be a development schedule that defines specific milestones. These milestones will include component-to-component interactions across the interfaces under development, and component insertion into demonstration scenarios. Among the milestones will be Technology Integration Experiments (TIEs). The TIEs will be conducted on a planned basis during the Execution Phase. Participants providing components shall participate in relevant TIEs.

At the Kickoff meeting, there will be technical breakouts to begin developing component interface definitions. The participants are expected to have systems and/or software engineers in attendance to assist in the initial assessment and interaction of the interfaces. This may include UML modeling of the interfaces. Use cases will be made available to the demonstration development team, and the interface definition team should incorporate in their own analysis use cases provided by the demonstration development team. As a way of validating the interfaces, they will be "exercised" against the demonstration scenarios.

Simultaneously, there will be technical breakouts at the Kickoff meeting to begin demonstration scenario design and creation. This activity will involve the development of use cases to explore the implications of the scenarios. These use cases should be made available to the interface development team, and demonstration developers should incorporate in their own analysis the use cases provided by the interface development team.

2.4 Phase D: Execution

The completion of the Kickoff marks the beginning of the Execution phase of the initiative. Using the agreed upon work package as the governing documents for the conduct of the initiative, the stakeholders will begin the principal tasks of refining engineering specifications as needed, developing components, and testing those components. The key outcome of the pilot initiative will be demonstrations, including capturing the demonstrations and making the demonstrations persistent.

To achieve the demonstrations, a series of design and testing activities will be needed. It is anticipated that TIEs will go through some number of iterations before the Components share information interoperably. A TIE is generally understood to minimally include a participant providing a client component and another participant providing a server component working in conjunction to test the implementation of a particular specification.

The primary goal of a pilot is to demonstrate the value of the interaction of a set of components that exercise a set of specifications in support of user defined scenarios. This capability will be instantiated in a persistent environment provided in part by the OGC Network. Therefore, participants will provide components and conduct TIEs to determine if these components can function in an interoperable environment. Typically there will be several "software builds" until interoperability in the environment is demonstrated via the TIEs.

If, during the course of Pilot Execution, modifications to existing open standards specification is found to be necessary, then a change proposal must be developed that documents the change. This change proposal does not need be adopted during the pilot, rather it is intended to serve as documentation of both the change and the requirement that led to the change. The change proposal will be submitted to appropriate standards developing organization.

To be successful, participants must execute four activities—designing a demonstration, building a demonstration, testing the demonstration, and packaging the demonstration on portable media.

The design activities will be used by the participants to clearly demonstrate the capabilities of the components by exercising the scenarios. As a core requirement of the pilot effort, all demonstrations be made available via the Internet.

Participation in demonstration exercises is predicated upon full engagement with development, testing, and planning activities throughout the initiative.

To finalize the demonstrations, a Demonstration Event will be convened to conduct the final integration of the components and to refine the steps in the demonstrations. During the demonstration event, the demonstrations will be captured through techniques such as client screen capture software. The demonstrations will then be made available for distribution. The Date and location for the Demonstration Event is provided in the Master Schedule contained in the main body of the CFP.

2.5 Phase E: Persistent demonstration

Once the Execution phase is complete, the components and demonstrations developed during the Execution Phase will continue to be made available. The persistent components will be available for persistent demonstration. This activity will result in configuration-controlled components that are considered stable enough to use in ongoing demonstrations.

3   Roles in Pilot Initiative

The following roles are defined for the Pilot of Pilot Initiative.

3.1 Participants

Participants are organizations that contribute to the definition of interfaces, prototypical implementations, scenario development and other support for an IP initiative. Participants are defined as organizations that have committed to contribute in a "substantial" amount. Participants are represented in an Initiative by business and technical representatives.

3.2 IP team

The Interoperability Program (IP) Team is an engineering and management team to oversee and coordinate an Interoperability Initiative. The IP Team facilitates architectural discussions, synopsizes technology threads, and supports the specification editorial process. The IP Team is comprised of OGC staff, representatives from organizations, and OGC consultants.

3.3 Sponsors

Sponsors are OGC Member organizations that contribute financial resources in support of a given initiative. They typically drive the requirements, technical scope and agenda, and demonstration form and content of an OGC IP initiative. Sponsor Representatives are personnel assigned by the Sponsor to represent the Sponsor's interests and position to OGC throughout the duration of a relevant initiative.

3.4 Observers

Observers are organizations that have been granted access to the initiative communication tools but are not contributing as participants. Observers are given full access to email lists, initiative web sites and regularly scheduled initiative wide teleconferences. Observers may make recommendations and comments to the participants via any of these fora. The Initiative Manager has the authority to table any comments, recommendations or other discussions raised by observers at any point without prior warning. Failure of an observer to comply may result in suspension of access.

4   Communications Plan

4.1 Distributed communication requirements

The communications plan supports development of the Initiative given the geographically distributed locations of the participants. Communication requirements include:

- The need to proactively and rapidly alert participants of events, deadlines, and decisions that affect them,
- The need to keep participants apprised of the status of all participants to ensure coordination and cross-communication,
- The need for participants to post items of interest, status reports, and software for distribution amongst the participants,
- The need for participants who are in remote locations to provide to IP Team or other participants with software for installation at various support sites, and
- The need for groups of participants to communicate/discuss and resolve ongoing definitional and development issues and related solutions.

The following sections describe communication to be used during the initiative

4.2 GEO webEx telecons

Telecons will be conducting using the combined webex and telecon facility provided by the GEO Secretariat. Details on the operations will be provided via the mailing lists.

4.3 GEO task e-mail reflector

E-mail will be exchanged for the GEOSS Pilot using the AR-07-02 Task listserv provided by the GEO Secretariat.

PLEASE NOTE: the email reflector is not intended for exchanging files with others. A procedure for uploading files to the project web sites is described below.

Additional e-mail reflectors will be set up for specific technical topics. This will reduce the e-mail traffic on the AR-07-02 list. The AR-07-02 list should not be used for extended discussions that are particular to only a small set of individuals.

4.4 GEO task FTP site

A directory for the GEO AR-07-02 Task has been created on the GEO FTP site that allows uploading of documents as well as downloading them. The folder has its own account, which will allow those with the username/password combination to upload files

ftp://ftp.wmo.int/Projects/GEO/EXCHANGE/

Downloading files is open to everyone.

Sub-directories for the Task will be established.

the username/password combination can be requested from:

- Hermen M. Westerbeeke, GEO) Secretariat, hwesterbeeke@geosec.org
- George Percivall, Task AR-07-02 lead, gpercivall@opengeospatial.org

4.5 OGC e-mail reflectors

E-mail reflectors may be provided the Open Geospatial Consortium web site as necessary to support communications of the FedEO and Tri-Lateral Pilots

4.6 OGC participant portal

A portion of the Open Geospatial Consortium Portal (in the Interoperability Program area) will be dedicated to communications of the FedEO and Tri-Lateral Pilots.

All three Pilots are summarized on the OGC Public Web page (http://www.opengeospatial.org/initiatives/)

5   Initiative Principles of Conduct

5.1 GEOSS references

The GEOSS approach to Governance is defined here:

http://www.earthobservations.org/about/about_GEO.html#governance

The GEO Rules of Procedure (GEO 0205-10) are available here

http://www.earthobservations.org/docs/GEO-II/GEO%200205-10%20GEO%20RULES%20OF%20PROCEDURE.pdf

5.2 Principles of Conduct

While non-binding, the following principles of conduct can support an effective pilot process:

1. Pilot participants extend respect and courtesy to their colleagues at all times.

Initiative participants come from diverse origins and backgrounds and are equipped with multiple capabilities and ideals. Regardless of these individual differences, participants treat their colleagues with respect as persons--especially when it is difficult to agree with them. Seeing from another's point of view is often revealing, even when it fails to be compelling.

English is the de facto language of the process, but it is not the native language of many process participants. Native English speakers attempt to speak clearly and a bit slowly and to limit the use of slang in order to accommodate the needs of all listeners.

2. Pilot participants develop and test ideas impartially, without finding fault with the colleague proposing the idea.

We dispute ideas by using reasoned argument, rather than through intimidation or ad homonym attack. Or, said in a somewhat more consensus-like way: "Reduce the heat and increase the light"

3. Pilot participants think globally, devising solutions that meet the needs of diverse technical and operational environments.

The goal of the initiative is to maintain and enhance a working, viable, scalable, global set of interfaces and protocols that provide a framework for interoperability in the geospatial domain. Many of the problems we encounter are genuinely very difficult. Participants use their best engineering judgment to find the best solution for the whole domain of geospatial interoperability, not just the best solution for any particular network, technology, vendor, or user.

Architecture Implementation Pilot
Call for Participation (CFP)
Annex B – Initial Architecture

CFP Issuance Date: 13 April 2007

Response Due Date: 11 May 2007

Pilot Kickoff Meeting: 5-6 June 2007

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1 Overview

1.1 Common Architecture and Standards

This Annex B defines the architecture for a Call for Participation (CFP) in a Architecture Implementation Pilot for Earth Observation information systems. This annex was developed based upon previous developments of the three Pilots.

- At the end of 2006, GEO released a Request for Information (RFI) for the GEOSS Clearinghouse and an RFI for the GEO Web Portal. Responses to the RFIs were compiled into a RFI Summary Document using the RM-ODP Viewpoints (See section 7.2 for more information about the RFI. See section 1.2 regarding RM-ODP).

- The FedEO Pilot content was proposed by ESA in dialogue with OGC and other Earth Observation agencies in December 2006. (See section 7.3)

- The Tri-Lateral Agreement, signed in January 2006, has been the basis for the identification of open standards and architecture for collaborative development for national and regional "Spatial Data Infrastructures" in Europe (INSPIRE), Canada (GeoConnections), and the U.S. (FGDC).

During the 1st Quarter of 2007, the commonality of the three initiatives was identified as a basis for collaborative pilot developments. While the individual pilots serve various objectives and communities, a common architecture is a basis for collaborative development. An aim of the Pilot of Pilots is to reach consensus on architectural elements that each of the initiatives can carry forward into operations, thereby increasing the overall level of interoperability.

1.2 RM-ODP Viewpoints

The architecture artifact in this CFP was developed using RM-ODP: ISO/IEC10746, Information technology — Open Distributed Processing — Reference model. The RM-ODP standards are used in multiple geospatial and earth observation architectures, e.g., the ISO 19100 series of geographic information standards, and the OpenGIS Reference Model. Following the RM-ODP process is also in line with the existing efforts of numerous Spatial Data Infrastructure (SDI) efforts that work towards providing geospatial services[i].

RM-ODP defines five viewpoints that are useful to separate the various concerns in developing an architecture. A summary of the RM-ODP Viewpoints is provided in Table 1.

Table 1 – RM-ODP Viewpoints

Viewpoint Name	Description of RM-ODP Viewpoint as used herein
Enterprise	Articulates a "business model" that should be understandable by all stakeholders; focuses on **purpose, scope, and policies**.
Information	Focuses on the **semantics** of the information and information processing performed.
Computational	**Service-oriented** viewpoint that enables distribution through functional decomposition of the system into objects that interact at interfaces.
Engineering	Identification of **component types** to support distributed interaction between the components.
Technology	Identification of **component instances** as physical deployed technology solutions, including network descriptions.

Note that the term "component" is used both in RM-ODP and in the GEOSS Component Registration Process. The two uses of the term differ slightly.

The CFP architecture does not contain a Technology Viewpoint. A Technology Viewpoint will be constructed based upon the results of the Pilot activities.

In addition to the set of viewpoints, the RM-ODP standard also defines a set of viewpoint languages. The architecture in this Annex does not use the RM-ODP Viewpoint Languages. The Unified Modeling Language (UML) language has been used to define some portions of the CFP Architecture. Additional development is anticipated during the course of the Pilots using ISO/IEC 19793, Information technology -- Open Distributed Processing -- Use of UML for ODP system specifications.

1.3 GEO Architecture Data and Committee (ADC) References

Other Task Teams of the GEO ADC has developed several documents in parallel with the Clearinghouse and Web Portal RFI. Several of the ADC documents are relevant to the Pilots Architecture. The revised Clearinghouse Architecture incorporates – directly or by reference – the following ADC documents[ii]:

- A Process for Reaching GEOSS Interoperability Arrangements (Developed by Task Team AR-06-01)
- GEOSS Interoperability Strategic Guidance (Developed by Task Team AR-06-02).

- GEOSS Components Registration (Developed by Task Team AR-06-04)
- GEOSS Clearinghouse: Demonstration of Existing Capability, Statement of Work, proposed, developed by Eliot Christian as an action of the ADC.

Also included in this document is a set of definitions developed by the ADC.

2 Enterprise Viewpoint – Value of Earth Observations

2.1 GEO community objective

As a "system of systems", GEOSS is composed of contributed Earth Observation systems, ranging from primary data collection systems to systems concerned with the creation and distribution of information products. Although all GEOSS systems continue to operate within their own mandates, GEOSS systems can leverage each other so that the overall GEOSS becomes much more than the sum of its component systems. This synergy develops as each contributor supports common arrangements designed to make shared observations and products more accessible, comparable, and understandable.[iii]

The technology defined in the other viewpoints of this architecture provide the detailed components and interactions which collectively are aimed to produce the GEO community objectives as an emergent behavior of the systems of systems.

 (Provide references to 10 yr plan; 10 yr plan reference document; to Strategic Guidance Document.)

2.2 Societal benefits

GEOSS will be primarily focused on issues of regional and global scale and on cross-sector applications, while also facilitating the operation and enhancement of Earth observing systems that are focused on national, local, and sector-specific needs. In this context, investments in Earth observations worldwide certainly exceed tens of billions of dollars per year. Those investments already yield substantial societal benefits, but those benefits will be increased through the collective actions enabled by GEOSS.[iv]

At present, GEOSS Implementation is concentrating on nine areas of societal benefits:
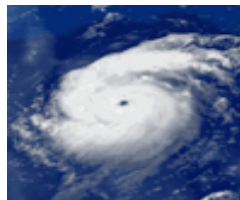
Reduction and Prevention of Disasters

Human Health and Epidemiology

Energy Management

Climate Change

Water Management

Weather Forecasting

Ecosystems

Agriculture

Biodiversity

2.3 Data sharing principles

A key part of that Implementation Plan are the GEOSS Data Sharing Principles: "There will be full and open exchange of data, metadata, and products shared within GEOSS, while 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 for use in education and research will be encouraged to be made available free of charge or at no more than the cost of reproduction."[v]

2.4 GEOSS interoperability arrangements

The success of GEOSS will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata, and products. GEOSS interoperability will be based on non-proprietary standards, with preference to formal international standards. Interoperability will be focused on interfaces, defining only how system components interface with each other and thereby minimizing any impact on affected systems other than where such affected systems have interfaces to the shared architecture.[vi]

2.5 GEOSS components

The overall GEOSS is a federated system that grows ever more useful over time as its constituent GEO Members and Participating Organizations link their contributed GEOSS components together. (GEO itself operates none of the components of GEOSS, other than a Web site and certain administrative facilities.) The components already contributed by GEO Members and Participating Organizations can be grouped in the following broad categories:[vii]

- **Components to acquire observations:** based on existing local, national, regional and global systems to be augmented as required by new observing systems;

- **Components to process data into useful information:** recognizing the value of modeling, integration and assimilation techniques as input to the decision support systems required in response to societal needs; and

- **Components required to exchange and disseminate observational data and information:** including data management, access to data, and archiving of data and other resources.

Focusing on the data exchange and dissemination components, the types of components fall into the seven key component categories[viii]:

- Catalogues and registries aiding discovery

- Applications interfacing to the internet and providing the user experience to web clients

- Means for identifying and accounting for users, and where necessary authenticating and authorizing their use of services

- Means for actually accessing and extracting required data

- Generating portrayals of data, such as maps

- Perform geographic processing on data
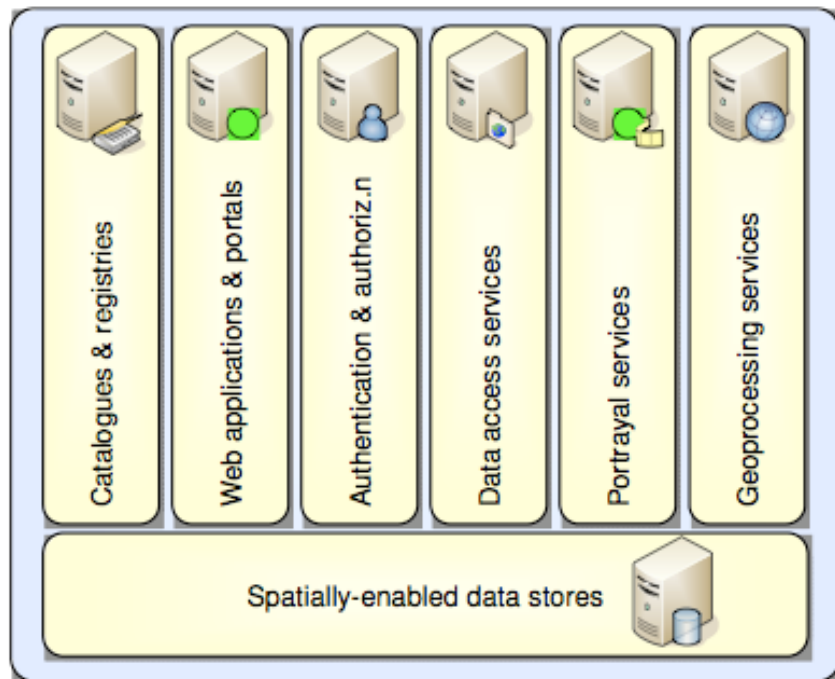
Figure 1 – GEOSS data exchange and dissemination services

A successful GEOSS architecture will reduce the clients' view of the current complex of inconsistent and disconnected set of services to one. This harmonisation will provide a consistent experience within which the user will be able to discover and access a variety of services offered by numerous disparate providers. At the same time the content and behaviour of these services will be predictable allowing the user to anticipate the results and use the services through a normal Internet connection. This idealized approach is represented as an "Internet bus" approach. [ix].
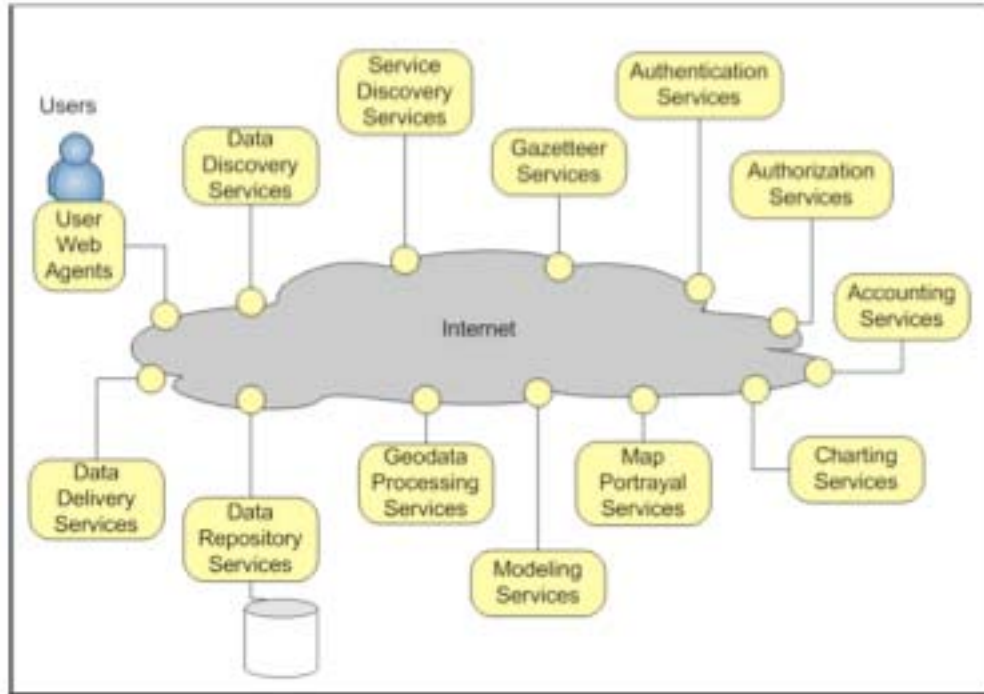
Figure 2 –The Internet Bus model

Systems intended to become GEOSS Components can only be contributed by GEO Members or Participating Organizations, and each of them must have endorsed the GEOSS 10-Year Implementation Plan.[x]

GEOSS Components may be designated at any time by any GEO Member or Participating Organization. These are in addition to those GEOSS components listed in the "Table of Initially Identified Systems" given as Annex 1 of the agreed GEOSS 10-Year Implementation Plan Reference Document. The procedure for designating additional contributed GEOSS components is defined in the GEOSS Components Registration document.[xi]

When the process for registering a GEOSS Component is complete, the contributed component will be listed in the GEOSS Component Registry[xii].

2.6 Pilot scenarios

The scenarios in this section provide a narrative description of functionality to be supported by the Pilot. These scenarios are written from an end-users point of view, e.g., policy maker, decision-maker, researcher, etc. Scenarios such as those described below will be used to develop the demonstrations, as an outcome of the pilots.

2.6.1 Disaster: Wildfires

Decision makers in an emergency response situation need rapid access to existing data, the ability to request and process data specific to the emergency and tools to rapidly integrate the various information sources into a basis for decisions.

An example of such a decision is responding to wildfires that threaten people, human developments or natural resources.

Context :

- Incident : Fire departure in a wild area near a big town and a high voltage line.
- Actors : Security Operations Commander (SOC) fire man and many different thematic service providers.
- Mission :
    - Convey fire man on the theatre,
    - Stop fire progression,
    - If it is not possible, contain the fire in a safe area,
    - If necessary, evacuate population in danger
- Includes services :
    - Alert Services
    - Sensor Observation Services
    - Catalogue Services
    - On-line access WMS – WCS – WFS
    - Context Services
- Field activities :
    - Radar and optical EO
    - Wind directions
    - Weather conditions
    - Supply information / map

Table 2 - Disaster Scenario: Wildfires

0	Incident	A fire in South Africa that threatens the high-voltage power lines.
1.	Alert/Notification, Establish COP	COP = Common Operational Picture
2.	Prepare to Deploy – Identify supporting resources	
3.	Plan the Deployment	
4.	Field Activities	

References for Wildfire Disaster Scenario:

- Wildfire response demonstration of OGC Web Services, Phase 3 (OWS-3) testbed

   The results of the demo are available here:

   http://www.opengeospatial.org/pub/www/ows3/index.html

   The plan for the wildfire demo is available here:

   http://portal.opengeospatial.org/files/?artifact_id=11880

2.6.2 Disaster: Tanker oil spill

Decision makers in an emergency response situation need rapid access to existing data, the ability to request and process data specific to the emergency and tools to rapidly integrate the various information sources into a basis for decisions.

This Scenario is of particular interest to the FedEO Pilot.

An example of a such a decision is responding to tanker breaking-out near a populated natural park that threaten people, human developments or natural resources.

Context : Incident : Breaking-up of a tanker near an ecological park.

- Actors : Emergency On-Call Office (ECO) and many different thematic service providers.
- Mission :
    – Evaluate the oil spill activities,
    – Detect the sensible area of the ecological park,
    – Estimate the environment injure,
    – Plan a Plan of Deployment.
- Field activities :
    – Radar and optical EO
    – Wind and flux directions
    – Weather conditions
    – Simulation
    – Supply information / map

Table 3 - Disaster Scenario: Tanker oil spill

Incident	The ECO is alerted from a breaking-out of a tanker near an ecological park.
1st step :	He wants to discover which data, products and services are available for this area of interest and this thematic. He connect to the FedEO networks.
2nd step :	After having identified some interesting products for his needs, he does a catalogue search of this products to have quicklook and more information.
3rd step :	He orders the identified products previously directly to the providers
4th step :	He does a feasibility check to know if he would be able to have better products.

5th step :	He receive the products from the provider via FTP protocol or WCS through an orchestrated chain.
6th step :	He maps the EO products in the viewer with other environmental, natural, fauna and flora information.
End state	He has all the needed information to help him to take the good decision for estimating the environment injures and to plan a Plan of Deployment in consequence.

2.6.3 Climate Change: Local effects

This scenario addresses how the Pilot Architecture will support citizens and policy makers in making local decisions based upon predictions of global climate change. Recognizing that the science to predict local changes is still advancing the workshop will define methods that GEOSS methods for users now and in the future to refine their understanding and the effects of global climate change on local decisions.

Humanity's influence on the global climate will grow in the coming century. Increasingly there will be climate-related changes that will affect each one of us. We must begin now to consider our responses.

Climate models have been developed to predict climate change, e.g., ecological models, hydrological models and socio-economic systems. Access to the model outputs is now becoming readily available to policy and decision makers. The model predictions must be combined with the local geographic and economic information to estimate the range of outcomes that will affect different locations in different manners.

Table 4 – Climate Scenario: Local effects

0	Identify locale and decision topic	
1.	Identify and understand predictive models	
2.	Combine model outputs with other data	
3.	Evaluate variability of model predictions	
4.	Develop recommendations	

References of Climate Change scenario:
- "Climate Change 2007: The Physical Science Basis - Summary for Policymakers",

IPCC, IPCC, February 5th, 2007, http://ipcc-wg1.ucar.edu/index.html
- "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond", Committee on Earth Science and Applications from Space,, National Research Council, 2007 http://www.nap.edu/catalog.php?record_id=11820
- "Climate Change Impacts on the United States. The Potential Consequences of Climate Variability and Change," 2001, National Assessment Synthesis Team, US Global Change Research Program. http://www.gcrio.org/orders/product_info.php?products_id=68
- "Getting Ahead of the Curve: Corporate Strategies That Address Climate Change," Andrew J. Hoffman, et. al., The University of Michigan, prepared for the Pew Center on Global Climate Change, October 2006
- "Stern Review on the Economics of Climate Change," http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm
- "Competitive Advantage on a Warming Planet," Jonathan Lash and Fed Wellington, Harvard Business Review, March 2007, pg 95.
- "Global Warming: Who Loses and Who Wins?," Gregg Easterbrook, The Atlantic, April 2007, p52

2.6.4 Ecosystems and biodiversity: Africa

This scenario addresses issues of decertification, land use and land cover change, deforestation, forest fires, hydrological resources and modelling, and resulting pressures on ecosystems and biodiversity to provide support to decision-makers in Africa. The CFP invites participation by organisations relevant to such a policy-relevant endeavor (e.g. related to demography, socio-economic pressures, humanitarian needs, health, and so on)

Natural ecosystems are in rapid decline. Major habitats are disappearing at a speed never observed before. The rate of species extinction is several orders of magnitude higher than the background or fossil rate. At the global level, the Convention on Biological Diversity to which the Community and Member States are parties - adopted in 2002 the target to significantly reduce the rate of biodiversity loss by 2010. The World Conservation Union (IUCN) Program on Protected Areas regards the network of protected areas within Africa as the principle safeguard for Africa's rich biodiversity. Protected areas are recognised as the most important core "units" for in situ conservation. These objectives range from the preservation of endangered species or landscapes to the protection of natural ecosystems. Uneven distributions of species diversity and threats to their continuing survival, as well as limited financial resources, mean that in order to achieve this goal, conservation priorities must be set.

The African Protected Area network forms an extensive set of sites that are of high conservation importance and form an efficient way of protecting our planet's biodiversity.

Table 5 – Africa Scenario

0	Identify the key questions for long-term decisions	Is the existing network of protected areas (PAs) for preserving biodiversity adapted for preserving hot spots of biodiversity and resilient to current and features threats?
1.	Evaluate the current value of PAs	Do the current PAs preserve the major groups of species and their habitats? Can we rank the existing PAs? Are important hot spots of biodiversity not covered?
2.	Evaluate the current threats on PAs	How human activities impact on the territorial integrity or connectivity of PAs? Can we identify the most threaten areas?
3.	Evaluate the future threats on PAs	How climate change and demographic increase will modify the biodiversity value and the threats (fires, droughts, floods, extractive activities, agriculture…)?
4.	Adapt the distribution of PAs	How can we mitigate the threats on biodiversity by measures on existing PAs and by creating new ones?

References for African Scenario:

- JRC programmes for"African Observatory"

  See for example http://ies.jrc.ec.europa.eu/tem.html

  Click on Menu Credits to show list of "References and links to data sources"

- Example of interactive services see http://www-tem.jrc.it/PA/index.html (select a country and a park to see functionality. Dynamic system integrating heterogeneous data to develop composite indicators of vulnerability)

- **The World Commission of Protected Areas (WCPA) mission is to promote the establishment and effective management of a world-wide representative network of terrestrial and marine protected areas, as an integral contribution to the IUCN mission. http://www.iucn.org/themes/wcpa/**

- The World Database on Protected Areas (WDPA) provides the most comprehensive dataset on protected areas worldwide and is managed by UNEP-WCMC in partnership with the IUCN World Commission on Protected Areas (WCPA) and the World Database on Protected Areas Consortium. The WDPA is a fully relational database containing information on the status, environment and management of individual protected areas. http://sea.unep-wcmc.org/wdbpa/

2.6.5 *Ecosystems and biodiversity: Polar (IPY)*

The poles of the earth provide for convergence on many topics. The Tri-Lateral Agreement partners have common geographic interest in the North Pole. The International Polar Year is a large scientific programme focused on the Arctic and the Antarctic from March 2007 to March 2009. IPY is organized through the International Council for Science (ICSU) and the World Meteorological Organization (WMO)

 (We have not yet identified a specific scenario for Polar (IPY). There has been discussion of biodiversity at the poles as a topic. Caribou tracking has been discussed.)

Relevant products could be Snow Covered Area (SCA) and Snow Water Equivalent (SWE) derived from EO data. These products are operationally produced in near real time in several areas and several places (US Modis products, national products, very large area products).

The products are widely used by water power industry, flood models, climate researchers etc. They think that for instance for the climate research community it could be very useful to know how this kind of information should be interpreted when combined from many sources (harmonization, metadata, accuracy).

The possible SDI linked project could concentrate on product validation and comparison: what kind of metadata is needed (pixelwise accuracy estimates, other metadata (specially for dynamic raster data like these products), coordinate systems to be used (same products are used nationally and globally), raster formats, different services (download, view, upload, discovery, transformation), cross boarder comparison, international existing standards to be adopted, …

Use case scenario: Climate Change reconnaissance for Polar Arctic

The objective of this use case scenario is to build a reconnaissance level overview of climate change impact in the Polar Artic, including but not limited to ecosystems and biodiversity. A series of national data themes (emphasis on polar projection and time series) will individually and a collectively demonstrate the potential impact of climate change on northern natural environment, economy and communities.

Data sets will be drawn from various data repositories via Web services as per Annex B (Architecture) of the CFP. For example the following datasets are candidates:

➢ Most recent national **climate change impact models** to show areas regions expect to be hotter, drier, wetter across the Arctic
➢ **Caribou migrations corridors** to demonstrate impact of climate change scenarios on a major economic species
➢ Annualized **AVHRR** to demonstrate to develop a time series of biological productively measures will indicate "biological resilience"

➢ National **DEM** data to show areas of potential sea level rise impact on coastals communities
➢ **protected areas** of the north to correlate with the above to demonstrate the potential impact of climate change and sea level rise on
➢ **Ecoregions** of the Artic
➢ **Open water** (polynias) and annual **sea ice** data to demonstrate the impact of species dependant on sea ice (such as polar bears)
➢ Locations of **monitoring stations** of various departments who part of the Arctic working group
➢ GeoBase **typonomy** layer and community locations.

Table 6 – Polar Scenario:

0	TBD	
1.		
2.		
3.		
4.		

References for Polar Scenario

- http://www.ipy.org/

- http://ess.nrcan.gc.ca/ipygeonorth/index_e.php

- the project POLARVIEW see http://www.polarview.org

This includes government agencies, research institutes, system developers, service providers, and end-users from Canada, Denmark, France, Finland, Germany, Iceland, Italy, Norway, Russian, Sweden, United Kingdom, and the United States. Polar View is supported by the European Space Agency and the European Commission, with participation by the Canadian Space Agency.

2.6.6 IPPP Scenarios

(Coordination is anticipated during the Pilot with the Scenarios being developed in GEO Task AR-07-01 by each of the IPPP pilots.)

3 Information Viewpoint – Earth Observations

3.1 Earth observation information model

There is little debate about the critical role of data standards in enabling SDI components to be effectively shared, and in particular to allow decomposition of responsibilities within a hierarchy of global to local jurisdictions[xiii].

"The Cookbook authors recommend that Core and non-Core data be modeled and shared in the designs of national SDI's using emerging ISO standards by following the rules for application schema, publishing a feature catalogue, and standardizing the encoding of the data." [GSDI Cookbook]

3.2 Features, coverages, observations and maps[xiv]

The starting point for modeling of geographic information is the geographic feature. A **feature** is an abstraction of a real world phenomenon. A geographic feature is a feature associated with a location relative to the Earth. A digital representation of the real world can be thought of as a set of features.

Any feature may have a number of properties that may be operations, attributes or associations. Any feature may have a number of attributes, some of which may be geometric and spatial. A feature is not defined in terms of a single geometry, but rather as a conceptually meaningful object within a particular domain of discourse, one or more of whose properties may be geometric.

Geographic phenomena fall into two broad categories, discrete and continuous. Discrete phenomena are recognizable objects that have relatively well-defined boundaries or spatial extent. Examples include buildings, streams, and measurement stations. Continuous phenomena vary over space and have no specific extent. Examples include temperature, soil composition, and elevation. A value or description of a continuous phenomenon is only meaningful at a particular position in space (and possibly time). Temperature, for example, takes on specific values only at defined locations, whether measured or interpolated from other locations.

These concepts are not mutually exclusive. In fact, many components of the landscape may be viewed alternatively as discrete or continuous. For example, a stream is a discrete entity, but its flow rate and water quality index vary from one position to another. Similarly, a highway can be thought of as a feature or as a collection of observations measuring accidents or traffic flow, and an agricultural field is both a spatial object and a set of measurements of crop yield through time.

Standardized conceptual schemas for spatial and temporal characteristics increase the ability to share geographic information among applications. These schemas are used by geographic information system and software developers and users of geographic information to provide consistently understandable spatial data structures.

A **coverage** is a feature that associates positions within a bounded space (its spatiotemporal domain) to feature attribute values (its range). Examples include a raster image, a polygon overlay, or a digital elevation matrix. Commonly used spatiotemporal domains include point sets, grids, collections of closed rectangles, and other collections of geometric objects. The range of a coverage is a set of feature attribute values. The attributes of a coverage, i.e., its range, are homogeneous across its domain. A Geographic imagery scene is a coverage whose range values quantitatively describe physical phenomena.

An **observation** is an event with a result which has a value describing some phenomenon. The observation event is modelled as a Feature within the context of the General Feature Model [ISO 19101, ISO 19109]. An observation feature binds a result to a feature of interest, upon which the observation was made. The observed property is a property of the feature of interest. An observation uses a procedure to determine the value of the result, which may involve a sensor or observer, analytical procedure, simulation or other numerical process.

A **map** is a portrayal of geographic information. While a map may be a digital image file suitable for display on a computer screen, a map is not the data itself.

GEOSS components utilize discrete features, coverages, observations and maps. Satellite imagery is a coverage and may be processed in to specific discrete features, e.g., hot spot points from a thermal-band image. Coverages and discrete Features are both need to support decision making by Societal Benefit Areas.

3.3 Spatial referencing

Spatial Referencing is accomplished is several ways including

- Terminology with spatial reference
- Coordinate reference systems

Many **terms** refer to locations near the surface of the earth, e.g., identifiers and place names. Spatial referencing with identifiers is when an identifier uniquely indicates a location, e.g., a postal code. Place names may be ambiguous, e.g, Springfield, requiring additional information to be resolved into a specific location. Gazetteers and geocoding are used to resolve the ambiguity.

Coordinates are unambiguous only when the **coordinate reference system** to which those coordinates are related has been fully defined. A coordinate reference system is a coordinate system that has a reference to the Earth. A coordinate reference system consists of a coordinate system and a datum. Types of coordinate reference systems include: geocentric, geographic (including an ellipsoid), projected, engineering, image, vertical, temporal. The datum defines the origin, orientation and scale of the coordinate system and ties it to the earth, ensuring that the abstract mathematical concept "coordinate system" can be applied to the practical problem of describing positions of features on or near the earth's surface by means of coordinates. Thousands of coordinate reference systems have been defined for various applications. The World Geodetic System (WGS) defines a coordinate reference system that is used with Earth Observation

data. frame for the earth, for use in geodesy and navigation. The latest revision is WGS 84.

3.4 Geographic information types

3.4.1 Basic Geographic Information Types [xv]

Definition: basic geographic data is such data as commonly used when geographic data are dealt, and is defined as one of followings in this guideline:

- Topography: data on undulation of earth surface such as contour lines and DEM.
- Bathymetry: data on topography of sea bottom.
- River systems: data on rivers and lakes
- Infrastructure: data on infrastructure such as roads and railroads
- Land Use / Cover: land use is to classify land by the function of land from human activity point of view. Land cover is to classify land by physical coverage of earth surface.
- Administrative Boundaries: spatial extent of administrative unit and its boundary. Coastline is included in this category.
- Residential Areas: areas where human settles collectively

3.4.2 Community Specific Information Types

(TBD – Methods to define and interoperate with community specific geographic information types, e.g., Feature Catalogues, Application Schemas, Product Types)

- GML Application schema for Earth Observation products

3.5 Registry Information Models

The GEOSS Registry Model is defined in Figure 3 and Figure 4
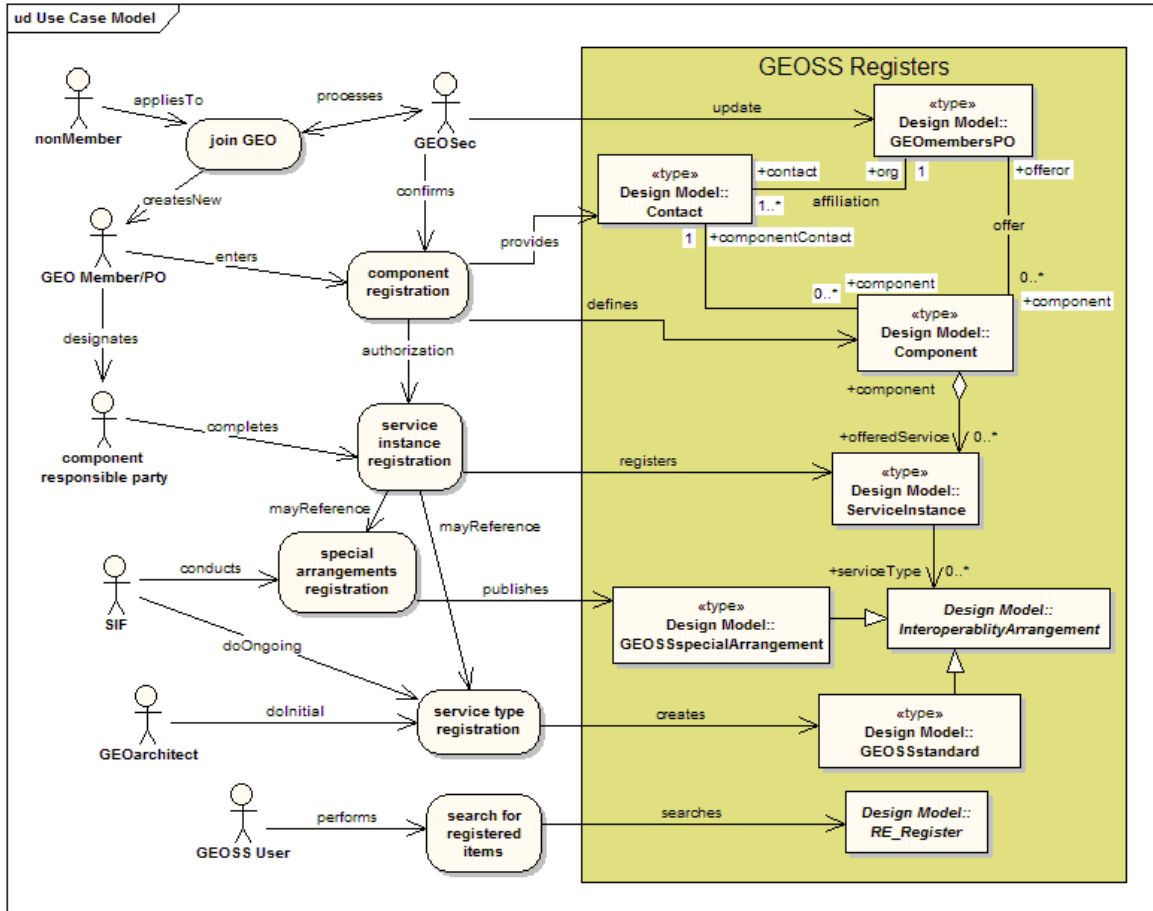
Figure 3 – GEOSS Registers Use Case Model
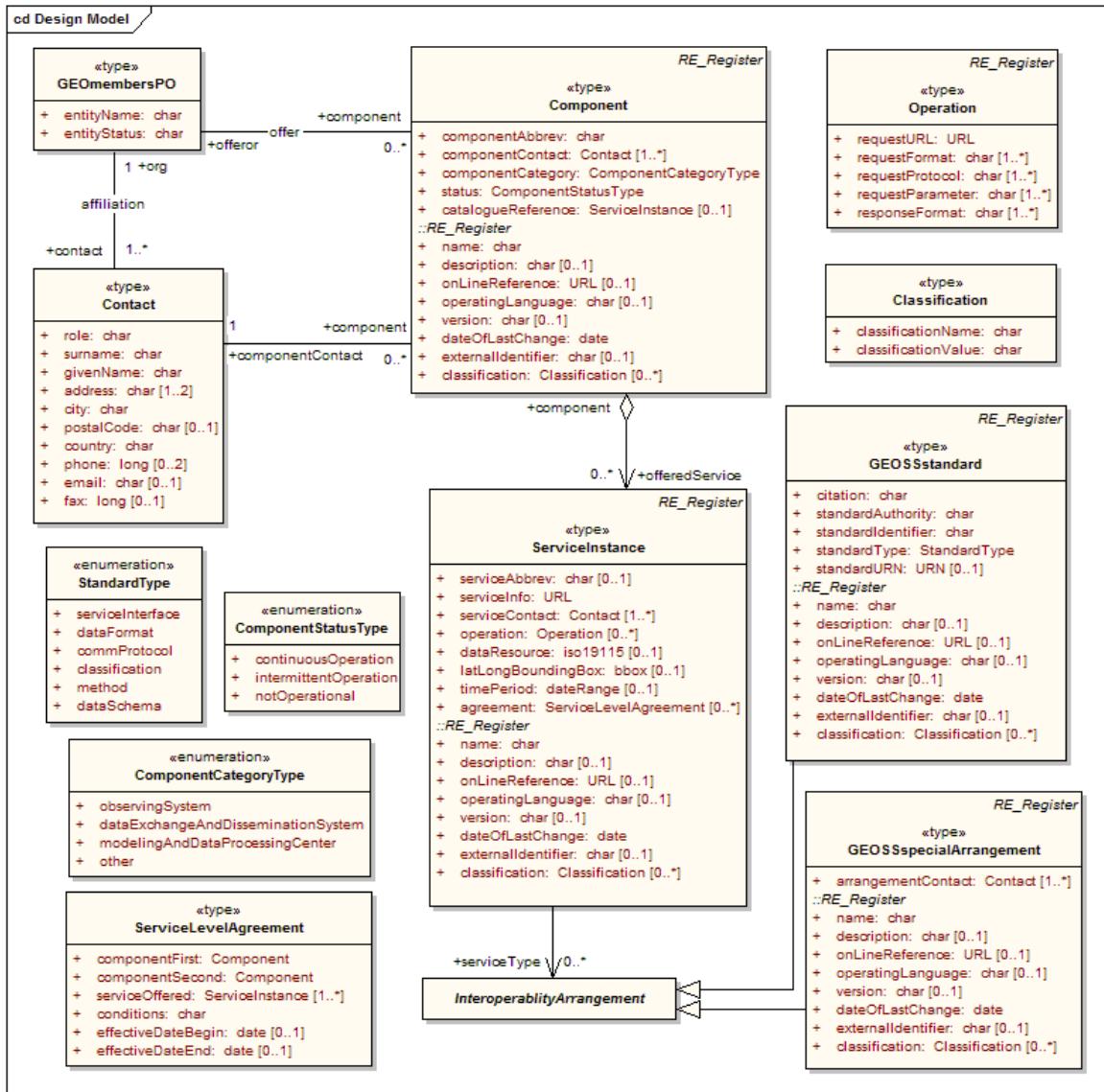
Figure 4 – GEOSS Registers Design Model

It is also important to register the semantics of shared data elements so that any system designer can determine in a precise way the exact meaning of data occurring at service interfaces between components. The standard ISO/IEC 11179, Information Technology--Metadata Registries, provides guidance on representing data semantics in a common registry[xvi].

The standard for geospatial metadata is ISO 19115: Geographic Information--Metadata. This standard facilitates the exchange and integration of data and information by giving a standard description of the identification, extent, quality, spatial and temporal scheme, spatial reference and distribution specifics of geospatial data[xvii].

The metadata standard to use should primarily be ISO 19115/19119/19139. Dublin Core been an international standard, it should be fully supported and not just "to be

considered". Following the two international standards, National standards, such as FGDC, may then be considered.[xviii]

3.6 Dataset metadata – searching

The GEOSS 10-yr IP Ref. Doc. identifies ISO 19115 as "the" standard for geospatial metadata, and certainly it will be listed in the GEOSS Standards Registry (beta version should be operational by the end of the month). But for the purposes of discovery, the few common elements that Eliot lists (title, author, subject, date, and place) are generally accessible through catalog search interfaces such as ISO 23950, which is also a GEOSS recommended standard. Is it desirable to have a slightly larger set of standard GEOSS metadata elements for discovery and evaluation?

Luckily, search interoperability for discovery is not much impacted by the variety in structures of metadata nor their particular elements. In actual practice, there are relatively few common search criteria that are used almost universally (title, author, subject, date, and place). The hundreds of additional metadata elements found in different disciplines are primarily used for evaluating the suitability of data rather than for discovering its existence. The content of these other metadata elements needs to be displayable, but rarely needs to be searchable individually. For display, it is adequate to render metadata directly from its XML representation. So, the various metadata schemas don't need to be fully mapped each to the other--one only needs to map certain elements to the commonly searchable criteria.

(Table identifying mandatory search points TBD)

3.7 Dataset metadata – response records

Yet, there are a couple areas where search interoperability for discovery does need attention and perhaps GEOSS could help. One area arises from current XML implementations and their patchy support for text encoding as needed for languages that use character sets other than Latin-1. As explained to me, application tool chains have varying levels of support for text encoding. Consequently, only a handful of encodings are actually supported when interoperating across a range of systems. For example, many software systems use the "expat" XML parser engine internally (a BSD licensed open source library), but that engine only supports ASCII, ISO Latin encodings, and Unicode (UTF-8 and UTF-16). When systems encounter XML with a standard Asian text encoding, software faults can occur at successive points in the chain of processing. At the "standards policy" level, GEOSS certainly embraces Unicode standardization of text encoding. But, the reality today is that there is still no guarantee that actually deployable systems are capable of the necessary conversions.

4   Computational Viewpoint – Service Oriented Interoperability

4.1 Service oriented architecture

The Computation Viewpoint defines mainly a Service-oriented approach to enable distribution through functional decomposition of the system into objects that interact at interfaces. There are exceptions to the services approach, e.g., direct satellite broadcast, delivery of data on media, but the predominant discussion is regarding a service oriented architecture.

GEOSS service definitions are to specify precisely the syntax and semantics of all data elements exchanged at the service interface, and fully describe how systems interact at the interface. At present, the systems interoperating in GEOSS should use any one of four open standard ways to describe service interfaces: CORBA, Common Object Request Broker Architecture; WSDL, Web Services Definition Language; ebXML, electronic business Extensible Markup Language, or UML, Unified Modeling Language.[xix]

GEOSS interoperability arrangements are to be based on the view of complex systems as assemblies of components that interoperate primarily by passing structured messages over network communication services. By expressing interface interoperability specifications as standard service definitions, GEOSS system interfaces assure verifiable and scaleable interoperability, whether among components within a complex system or among discrete systems[xx].

4.2 Service tiers[xxi]

The components are best characterized as part of a service layer in the ISO 3-tier model (Figure 5):

- The top tier is the only one with which clients (people or systems) deal directly. It provides the interfaces to describe and use the services offered;

- The middle tier embodies all the business processes required to respond to requests issued by clients. The services in general embody everything from authentication to complex geoprocessing on sets of data from various repositories and from generation of map views to statistical charts that the client gets back at the end of the process;

- The lower tier provides read and/or write access to data, whether its geospatial data, accounting records, or catalogue entries stored in any of a dozen different types of registries.
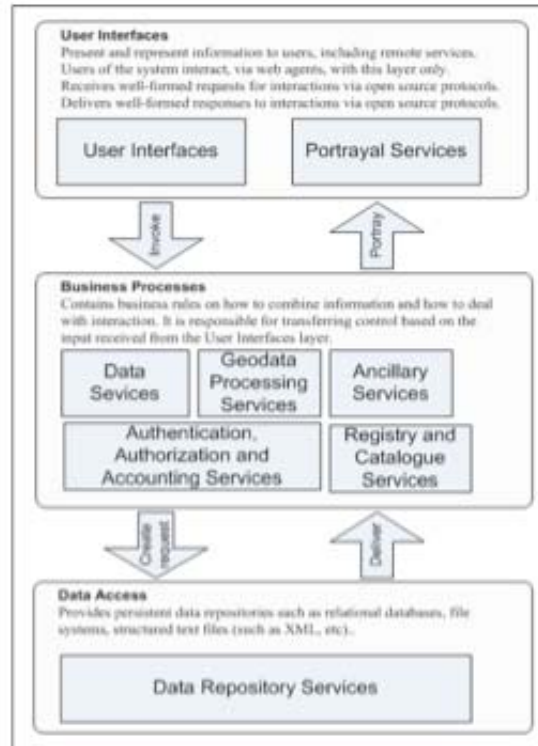
Figure 5 – Service Tiers: User, Business and Data

4.3 Catalog Service Standards

4.3.1 Overview

Interoperability arrangements for catalog search are key to as service oriented architecture. The GEOSS 10 Year Plan Reference Document identified ISO 23950 as a standard needed for use in GEOSS to search catalogs of interest. Responses to the Clearinghouse RFI identified several catalog standards that are essential to GEOSS. The RFI responses primarily recommended use of the OGC Catalogue Service - Catalog Service for the Web (CSW).

Many Earth Observation catalogues have adopted ISO 23950 Protocol for Information Search and Retrieval. This search service is interoperable with a broad range of information resources and services, including libraries and information services worldwide as well as the Clearinghouse catalogues supported across the Global Spatial Data Infrastructure now implemented in more than 50 countries.[xxii].

Profiles of the OGC CSW specification namely the ebRIM, ISO 19115/19119, and Earth Observation application profiles were identified as area to be investigated and tested in the Proof of Concept Phase, i.e., before the Call for Participation in the Architecture Implementation Pilot was released.

The GEOSS Clearinghouse will need to be a client to community catalogue servers implemented in accordance with multiple catalog service standards, at a minimum these include ISO 23950 and OGC CSW.

(It has been suggested to refer only to the OGC Catalog specification as the only Catalog spec supported by the GEOSS Clearinghouse. Then this includes SRW, OGCCORE and the two application profiles, ISO and ebRIM.[xxiii])

With respect to the metadata supported by the clearinghouse, it is expected that additional classification schemes may be needed to support search by societal benefit area, type of resource, etc. This approach has been successfully implemented in ESG such that when a resource is registered (or harvested) in the catalog, the publisher has the option of also specifying additional information such as the type of resource, the supported NASA national application, the applicable ISO categories, etc. This approach allows users to be able to narrow down their searches considerably, especially in a distributed global environment.

A combination of the distributed search and harvested search approaches is recommended based on GIO's experience with ESG. In ESG, the metadata in other catalogs is harvested and stored in ESG but that metadata is refreshed based on a frequency determined by the publisher or the system administrator. This mixed approach ensures reasonable system response times while maintaining a good degree of up-to-dateness of search results.

For practical reasons, it is recommended that the search interface allow users to be able to specify (or select) the underlying catalogs that they wish to search for a certain query. Supporting this functionality may also improve performance as the clearinghouse won't have to issue queries to all its underlying catalogs if the user is only interested in a couple at a time.

4.3.2 Catalog service – ISO 23950[xxiv]

The ISO 23950 standard defines a network client-server service whereby a client can precisely specify a search request and preferences for the response that retrieves search results. The standard includes a definition for search request/response using TCP/IP protocol, also defined as a Protocol Binding in OGC Catalog Services, and using HTTP (Hypertext Transfer Protocol) known as SRW (Search and Retrieve for the Web) or SRU (Search and Retrieve via URL, see http://www.loc.gov/standards/sru/). SRW and SRU are designed for both the HTTP GET and HTTP POST interfaces, and for both Web Services using SOAP (Simple Object Access Protocol) as well as CGI (Common Gateway Interface, formally specified in RFC 1738). The vast majority of ISO 23950 implementations are served via TCP/IP rather than over HTTP. HTTP access to ISO 23950 over TCP/IP may be provided through an SRU-to-Z39.50 protocol gateway (see indexdata.dk).

The ISO 23950 standard defines a network client-server service whereby a client can precisely specify a search request and preferences for the response that retrieves search results. The standard includes a definition for search request/response using the HTTP (Hypertext Transfer Protocol). This part of ISO 23950 is known as SRW (Search and Retrieve for the Web) or SRU (Search and Retrieve via URL, see

http://www.loc.gov/standards/sru/). SRW and SRU are designed for both the HTTP GET and HTTP POST interfaces, and for both Web Services using SOAP (Simple Object Access Protocol) as well as CGI (Common Gateway Interface, formally specified in RFC 1738).

For example, the following ISO 23950 SRU search request finds Library of Congress catalog entries containing the word "fruit":

http://z3950.loc.gov:7090/voyager?operation=searchRetrieve&version=1.1&maximumRecords=20&recordSchema=dc&query=fruit

As required by RFC 1738, the request has two component parts: a "base URL" and a "searchpart", separated by a question mark ("?"). The base URL identifies the server host and port (here, "z3950.loc.gov:7090") and the ISO 23950 service (here, "voyager"). The searchpart consists of parameters separated by "&", each with the structure "key= value". The names of the parameters in this ISO 23950 service description are the "key" strings within the URL, here: "operation", "version", "maximumRecords", "recordSchema", and "query".

Here is an example of an ISO 23950 SRU search request using a geospatial index:

http://www.search.gov/gsdi/sru2kml.php?operation=searchRetrieve&version=1.1&maximumRecords=100&recordSchema=XML&query=geo.bounds within/partial/nwse "43.772 -101.411 31.7723 -77.7499"

This example specifes that the search targets the "geo.bounds" index, an index for bounding coordinates defined for the geospatial search community. This kind of search is not a text matching operation, but a search for points of overlap between available geosgraphic "footprints" and the area being searched. The concept of overlap is given here by the search qualifier: "within/partial". The query also specifies, through the "nwse" qualifier, that the bounding box is given in decimal degrees of latitude and longitude, with coordinates in the order of northernmost, southernmost, westernmost, easternmost.

4.3.3 Catalog service – OGC CSW

The OpenGIS Catalogue Services Specification[xxv] specifies the interfaces between clients and catalogue services, through the presentation of abstract and implementation-specific models. Catalogue services support the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects. Metadata in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software. Catalogue services are required to support the discovery and binding to registered information resources within an information community.

The OGC Catalogue specification contains bindings of the abstract catalog model to specific transport protocols. The Catalogue Services for the Web (CSW) binding applies the abstract model to the HTTP protocol.

With CSW the interaction between a client and a server is accomplished using a standard request-response model of the HTTP protocol. That is, a client sends a request to a server using HTTP, and expects to receive a response to the request or an exception message.

Request and response messages are encoded as keyword-value pairs within a request URI or using an XML entity-body. Requests may also be embedded in a messaging framework such as SOAP.
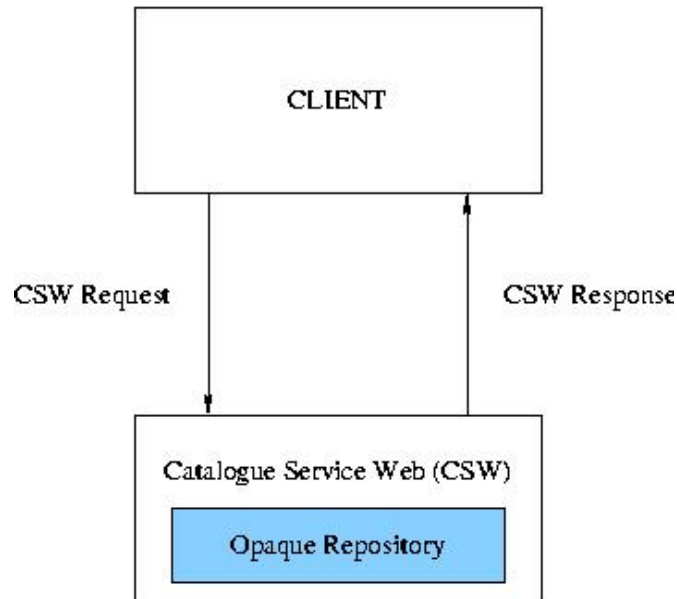
Figure 6 — Catalogue service web

The CSW binding has been implemented with profiles for specific information models for the content of the repository accessible using the CSW.

4.4 Web Map Service

OGC Web Map Service (WMS) version 1.3 is identical with ISO 19128:2005, Geographic information – Web Map server interface.

Currently most implementations use OGC WMS version 1.1.1.

The OGC Context documents facilitate inter-tool interoperability and can support collaboration and information sharing in the GEOSS environment.[xxvi] The Web Map Context Specification defines an XML document that contains map metadata and enough information to retrieve a particular map from WMS servers. It can be thought of as a bookmark to a specific map.

4.5 Data access services

4.5.1 Web Feature Service

The OpenGIS Web Feature Service (WFS) allows a client to retrieve and update geospatial data encoded in Geography Markup Language (GML) from multiple Web Feature Services. The specification defines interfaces for data access and manipulation operations on geographic features, using HTTP as the distributed computing platform. Via these interfaces, a Web user or service can combine, use and manage geodata -- the feature information behind a map image -- from different sources.

The following WFS operations are available to manage and query geographic features and elements:

  * Create a new feature instance

  * Delete a feature instance

  * Update a feature instance

  * Lock a feature instance

  * Get or query features based on spatial and non-spatial constraints

4.5.2 Web Coverage Service

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

A WCS provides access to potentially detailed and rich sets of geospatial information, in forms that are useful for client-side rendering, multi-valued coverages, and input into scientific models and other clients. The WCS may be compared to the OGC Web Map Service (WMS) and the Web Feature Service (WFS); like them it allows clients to choose portions of a server's information holdings based on spatial constraints and other criteria.

4.5.3 GEONetCast Direct Broadcast

(description to be supplied)

4.6 Other service types

A standardized, harmonized set of interfaces that support a service oriented view of the heterogeneous mission ground segments, can be implemented in a cost-effective manner using open standards. This will enable the construction of compound / value added services from basic interfaces.[xxvii] In addition to the services listed in the previous paragraphs, these services are anticipated to be used in the Pilots:

• Ordering Services for Earth Observation Products

• Sensor Planning Service (SPS) for commanding EO Sensors

- Sensor Observation Service (SOS) for access data from web accessible sensors.

- Web Processing Service (WPS) for requesting execution of programming on EO data.

- Web Coordinate Transformation Service

- Workflow management for controlling the execution of a chain of web services.

5 Engineering Viewpoint – Components Types

5.1 Engineering Viewpoint Summary

The Engineering Viewpoint identifies of component types to support distributed interaction between the components. The component types are to be consistent with the Enterprise viewpoint, e.g., GEOSS as a system of systems. The component types interact based upon the services identified in the Computational Viewpoint. Figure 7 provides a summary of the component types organized consistent with the Service Tiers identified in the Computational Viewpoint. To limit the complexity of the diagram, interactions between components is not made explicit in Figure 7. Services supported by specific component types is described in the section for the specific component types.
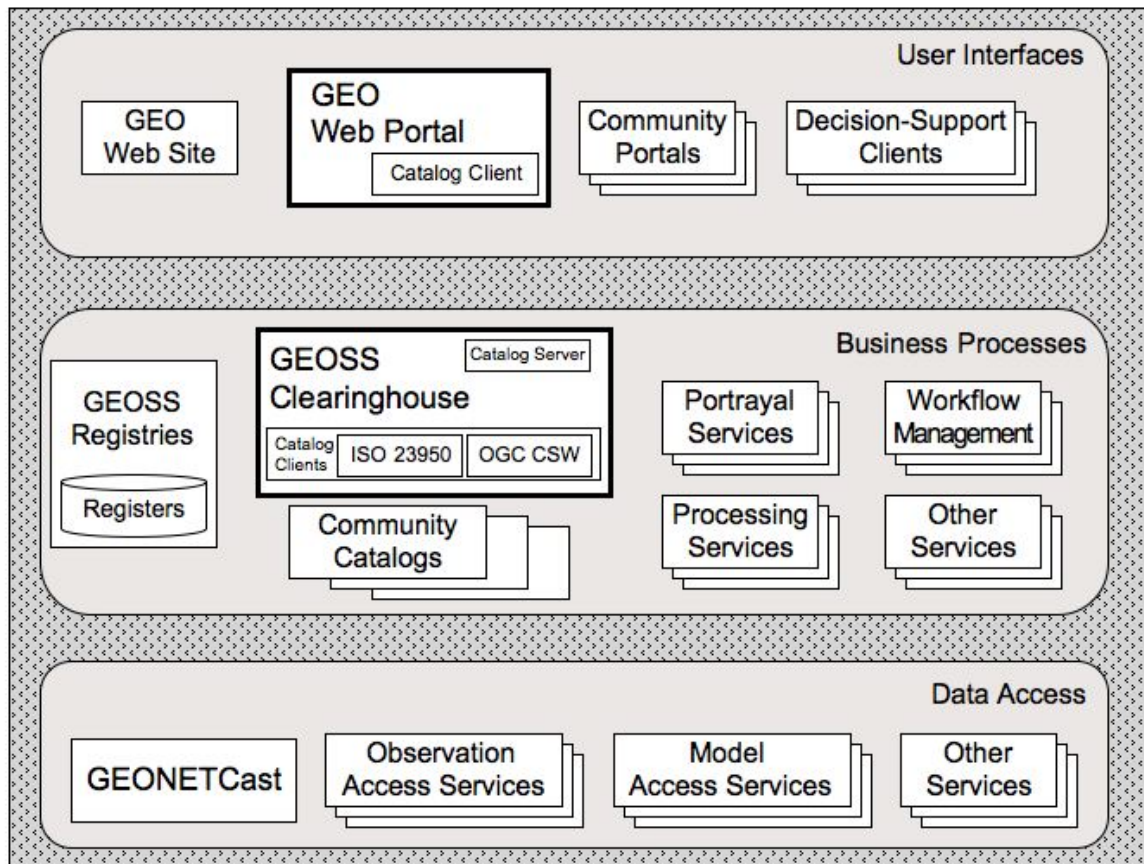

Figure 7 – Engineering Viewpoint Components

5.2 Interoperability arrangements

At minimum, all GEOSS Components are bound by the requirements on contributed systems as stated in The GEOSS 10 Year Implementation Plan and its companion

Reference Document. These stated requirements, referenced in GEOSS documents as "interoperability arrangements", are expected to be further expanded, clarified, or otherwise modified over time. Any new GEOSS Component is understood to be bound by the GEOSS interoperability arrangements as documented at the time it was contributed[xxviii].

Following are excerpts of interoperability requirements on contributed systems as stated in the GEOSS 10-Year Implementation Plan
("5.3 Architecture and Interoperability", page 7):

> The success of GEOSS will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata, and products. GEOSS interoperability will be based on non-proprietary standards, with preference to formal international standards. Interoperability will be focused on interfaces, defining only how system components interface with each other and thereby minimizing any impact on affected systems other than where such affected systems have interfaces to the shared architecture.

> For those observations and products contributed and shared, GEOSS implementation will facilitate their recording and storage in clearly defined formats, with metadata and quality indications to enable search, retrieval, and archiving as accessible data sets. [...]

> To enable implementation of the GEOSS architecture, GEOSS will draw on existing Spatial Data Infrastructure (SDI) components as institutional and technical precedents in areas such as geodetic reference frames, common geographic data, and standard protocols. GEO Members and Participating Organizations and their contributions will be catalogued in a publicly accessible, network-distributed clearinghouse maintained collectively under GEOSS. The catalogue will itself be subject to GEOSS interoperability specifications, including the standard search service and geospatial services.

The Process for Reaching GEOSS Interoperability Arrangements document defines the steps by which an interoperability arrangement is determined including the activities of the Standards and Interoperability Forum.

A procedure for evaluating interoperability is provided in the GEOSS Component Registration document.

Table 7 provides a summary of open standards that have been identified in the previous viewpoints of this architecture. These standards may be considered for consensus adoption as Interoperability Arrangements to be used during the Pilots.

Table 7 – Potential Interoperability Arrangements Summary

Information Viewpoint	
ISO 19111	Geographic Information – Spatial Referencing by Coordinates
ISO 19115	Geographic Information – Metadata
GML 3	OGC Geography Markup Language (GML) also published as ISO 19136
(GeoTIFF)	
(ANSI Framework Data)	
ISO 19135	
Computational Viewpoint	
CSW	OGC Catalog Interface (CAT) version 2.0.1. Includes Catalog Service for the Web (CSW) as well as Z39.50 bindings for ASN.1 and SRW.
CSW ebRIM AP	Catalogue Services – ebRIM (ISO/TS 15000-3) profile of CSW
CSW ISO AP	Catalogue Services – ISO19115/ISO19119 Application Profile for CSW
UDDI	
Z39.50	
WMS1.3	OGC Web Map Service
WMS Context	OGC Web Map Context Documents
WFS 1.1	OGC Web Feature Service
WCS 1.1	OGC Web Coverage Service
	GEONetCast DBS spec.
WCTS	OGC Web Coordinate Transformation Service
SOS	OGC Sensor Observation Service
SPS	OGC Sensor Planning Service
WSDL	Web Services Description Language
BPEL	OASIS Business Process Execution Language

5.3 Engineering Use Cases

5.3.1 Use Case Introduction

Use cases are examples to show the use of services in specific configurations associated with the components of this architecture. The use cases are not exhaustive – there will be many additional ways that the services are used. These use cases are the building blocks that will be used to achieve the Scenarios defined in the Enterprise Viewpoint.

5.3.2 Publish-Find-Bind

The Publish-Find-Bind use case is a basic building block of a service-oriented architecture.
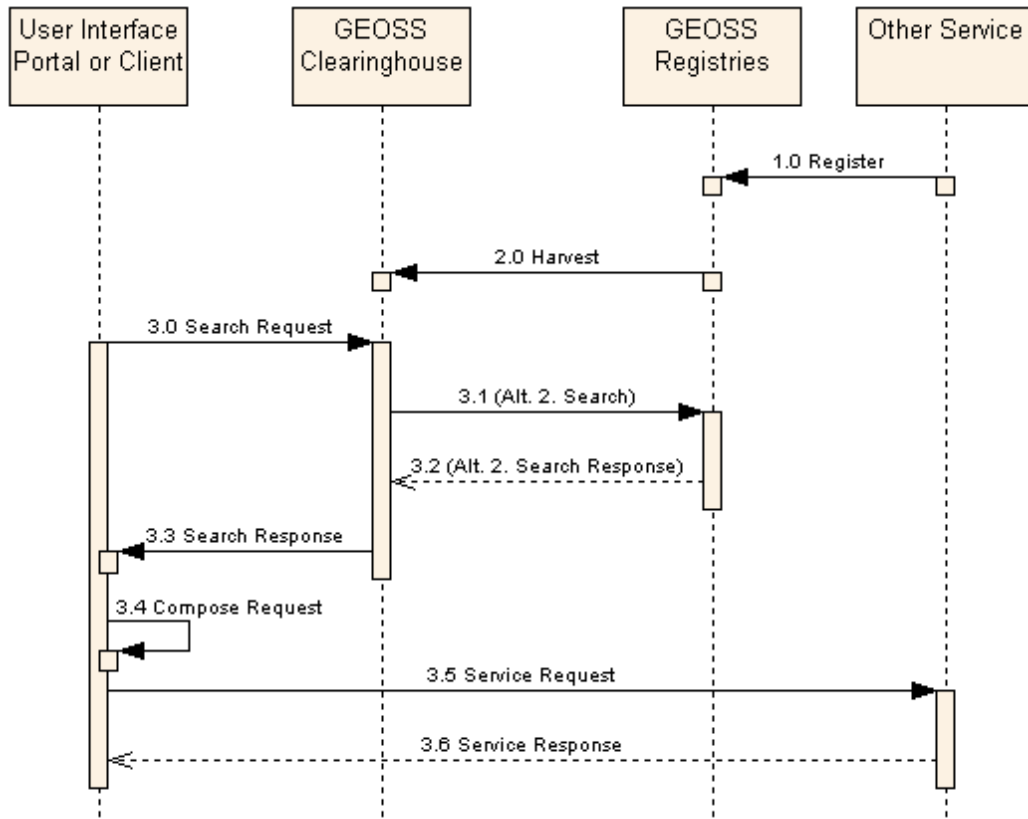
Figure 8 - Publish-Find-Bind Sequence

Table 8 - Publish-Find-Bind Steps

Step Label	Description
Initial Conditions	• Components have been registered in GEOSS Component Registry • In this use case "other service" is any service that conforms to GEO Interoperability Arrangements
1.0 Register	Other Service is registered in the GEOSS Registry
2.0 Harvest	GEOSS Clearinghouse harvests service registry from the GEOSS Registry, asynchronously from user interface search requests
3.0 Search Request	User Interface invokes a search request for services on the GEOSS Clearinghouse. In the strict sense, on the

	GEOSS Clearinghouse Catalog service
Alternative 3.1. Search	GEOSS Clearinghouse searches GEOSS Registry when a search request is received from User Interface.
Alternative 3.2 Response	GEOSS registries respond with a search response.
3.3. Search Response	GEOSS Clearinghouse responds with a search response including URL to invoke other service.
3.4. Compose Request	User Interface client parses search response and composes Service Request potentially including interaction with user for additional information.
3.5. Service Request	User Interface client requests service.
3.6. Service Response	Other service responds.

5.3.3 Distributed Search

Distributed search is a primary function of the GEOSS Clearinghouse. Distributed searching assumes that multiple catalogs will be accessible. While harvesting some portion of the metadata from some catalogues will occur in advance, it is not practical in a system of system to centralize all metadata from all catalogs.
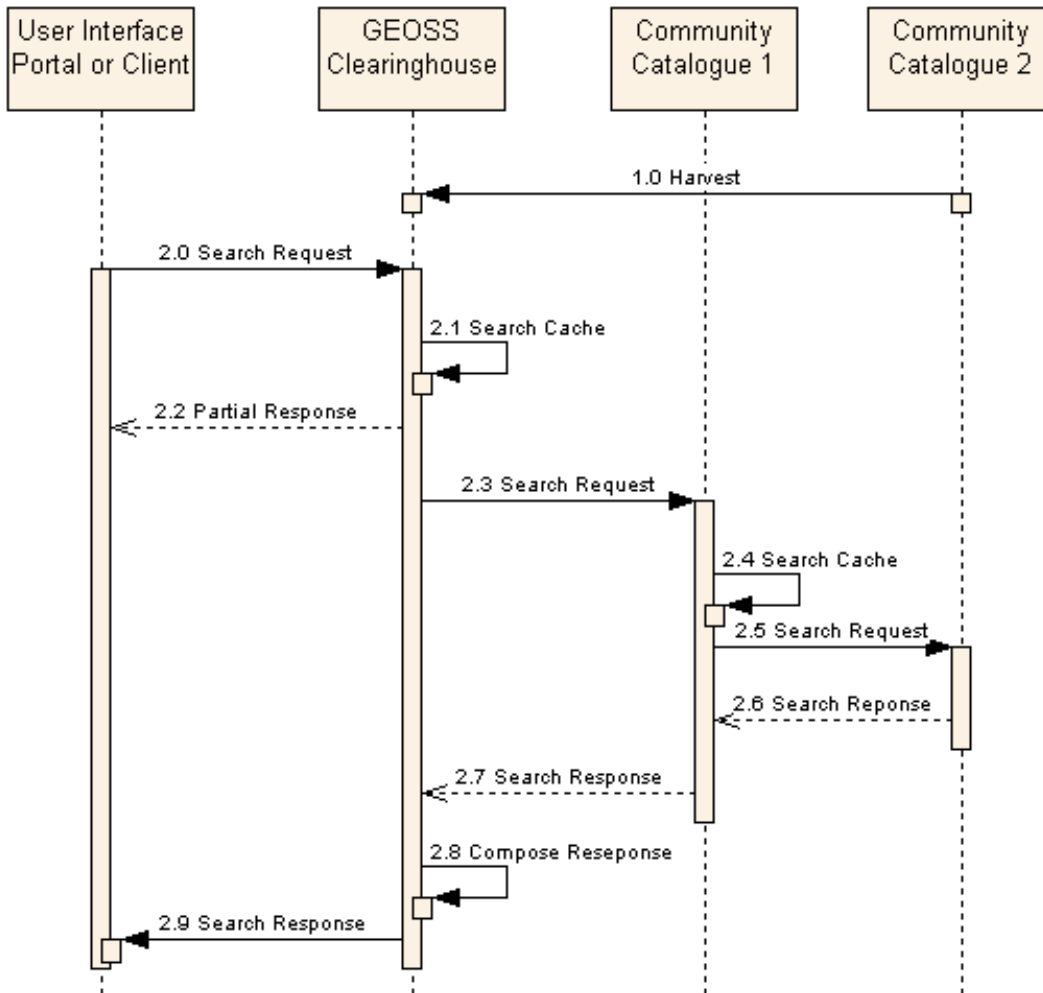
Figure 9 – Distributed Search Sequence

Table 9 - Distributed Search Steps

Step Label	Description
Initial Conditions	Components and services have been registered in GEOSS Component Registry
1.0 Harvest	GEOSS Clearinghouse harvests some portion of metadata from some community catalogues.
2.0 Search Request	User Interface invokes a search request for services on the GEOSS Clearinghouse Catalog service.
2.1 Search Cache	GEOSS Clearinghouse searches internal cache. Internal cache may include metadata from GEOSS Registry and Community Catalogues if previously

	registered or harvested.
2.2 Partial Response	GEOSS Clearinghouse responds, providing a result set based on its internal cache.
2.3. Search Request	GEOSS Clearinghouse invokes a catalogue service request on a Community Catalogue (1).
2.4 Search Cache	Community Catalogue searches internal cache.
2.5 Search Request	Community Catalogue invokes a catalogue service request on an other Community Catalogue (2).
2.6 Search Response	Community Catalogue (2) responds with search result to Community Catalogue (1)
2.7 Search Response	Community Catalogue (2) responds with combinded search result from internal cache plus results provided by Community Catalogue (2) to CommunGEOSS Clearinghouse
2.8 Compose Responses	GEOSS Clearinghouse combines the search responses from the Community Catalogues with metadata from Clearinghouse Cache.
2.9 Service Response	GEOSS Clearinghouse responds to User Interface with composite response.

5.3.4 Visualization of EO Data

Visualization of Earth Observation data is a primary mode of interaction for human users with the EO data. Portrayal Services created pictures of data, e.g., maps. The map visualization of EO data can then be combined with other geographic data accessible from WMS services.
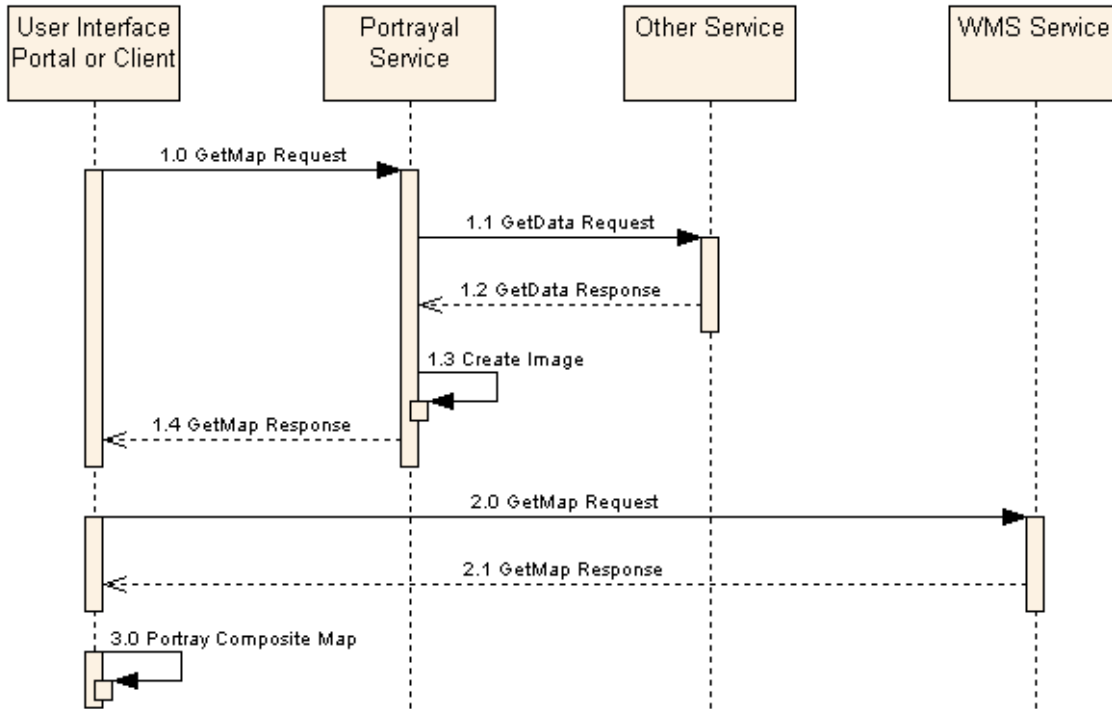
Figure 10 – Visualization of EO Sequence

Table 10 - Visualization of EO Steps

Step Label	Description
Initial Conditions	• Components and services have been registered in GEOSS Component Registry • User Interface Portal or Client has knowledge of a data source and a suitable portrayal service. • Examples of Other Services include WFS, WCS, and CSW.
1.0 GetMap Request	User Interface Portal or Client creates a getMap request including the URL of the Other Service and styling information.
1.1 GetData Request	Portrayal Service accesses data from Other Service using the URL in the GetMap Request of step 1.
1.2 GetData Response	Other Service responds with data.
1.3 Create Image	Portrayal Service creates an image from data by applying the styling information from step 1.
1.4 GetMap Response	Picture of the data is sent to the User Interface
2.0 GetMap Request	User Interface requests additional maps of the same

	geographic extent from WMS services.
2.1 GetMap Response	WMS service responds with map picture
3.0 Display Composite Map	User Interface creates a composite map by overlaying the maps.

5.3.5 Processing of Service Responses

Earth Observation data will not always be well-suited to a specific purpose and will need processing specific to the users needs. This situation is typical in environments were data is acquired and archived for one application but this is accessed for by a user with a different application than the original application.
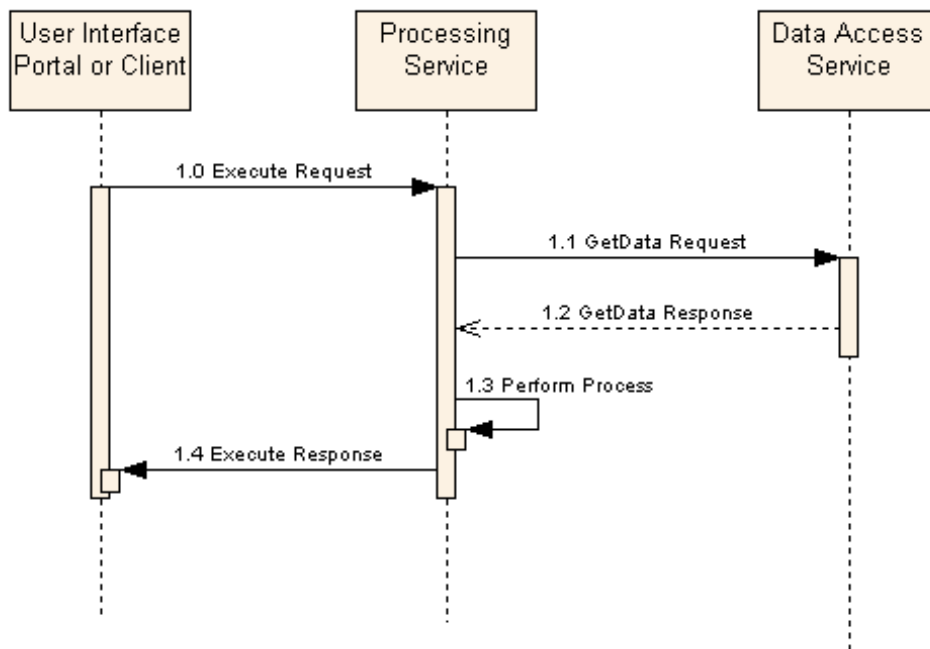
Figure 11 – Processing of Service Response Sequence

Table 11 - Processing of Service Response Steps

Step Label	Description
Initial Conditions	• Components and services have been registered in GEOSS Component Registry • User Interface Portal or Client has knowledge of a data source and a suitable processing service, e.g., WPS.

	• Examples of Data Services include WFS and WCS.
1.0 Execute Request	User Interface Portal or Client creates a Execute request including the URL of the Data Service and processing parameters.
1.1 GetData Request	Processing Service accesses data from Other Service using the URL in the Execute Request of step 1.
1.2 GetData Response	Data Service responds with data.
1.3 Perform Process	Processing Service creates value-added data by applying the performing the processing using the parameters from step 1.
1.4 Execute Response	Value-added data is sent to the User Interface

5.3.6 Workflow execution

The previous use cases can be combined in a multitude of ways in order that the user receives the information suited to their decision, research, etc. As multiple services are combined into a chain of services a workflow is defined. The workflow can be stored in a scripting language, e.g, BPEL. Control of a service chain can be automatically controlled by a workflow management service. The workflow shown here is one example of many.
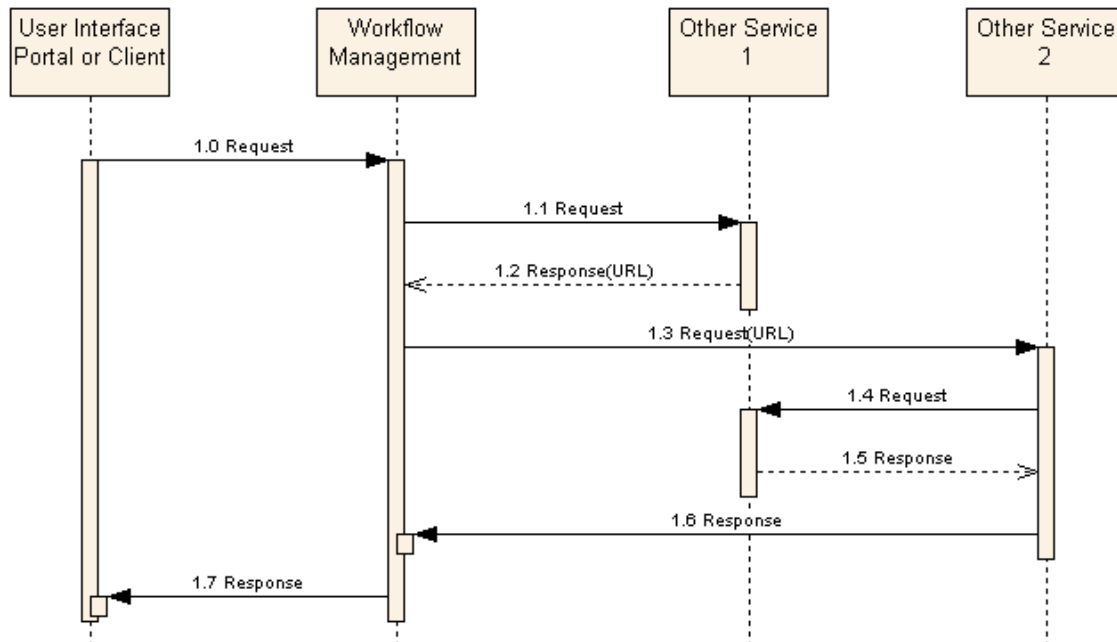
Figure 12 – Workflow Execution Sequence

Table 12 - Workflow Execution Steps

Step Label	Description
Initial Conditions	• Components and services have been registered in GEOSS Component Registry • A workflow script has been created previously and exists in the workflow engine. • Examples of Others Services include Portrayal Services, Processing Services and Data Access Services and Catalogues.
1.0 Request	User Interface Portal or Client creates a request on the Workflow Management service.
1.1 Request	Workflow Management service initiates the service chain by sending a request to an Other Service.
1.2 Response (URL)	Other Service responds typically with a response that the data is available at a URL that is provided in the response.
1.3 Request (URL)	Workflow Management service reviews the script to determine the next step in the chain and sends a request to an Other Service. The request includes the URL of the intermediate product in step 3.
1.4 Request	Other Service requests intermediate product from Other Service.
1.5 Response	Other Service responds with intermediate product from Other Service.
1.6 Response	Other Service performs additional processing on intermediate product and produces a final product to the Workflow Management service.
1.7 Response	Workflow Management service sends final product to User Interface.
Alternative for 1.6 and 1.7	Instead of the final product being sent to the Workflow Management service, the Other Service returns a URL of the final product that is sent on to the User Interface. User Interface then uses URL to acquire final product directly from the Other Service.

5.3.7 Ordering products

(To be developed: Use case for on-line ordering of EO products which are delivered asynchronously either by network or media)

5.3.8 Product Delivery via GEONETCast

(To be developed: use case for discovering an metadata recored for a product that is subsequently accessed using the a client that can receive GEONETCast broadcasts.)

5.4 User Interface Components

5.4.1 GEO Web Portal

Geospatial portals typically contain a number of common functions and solutions. These include functions and solutions to search and discover services and provide news and other relevant information to the user community. Portals also offer administrative functions for service suppliers and users. Core services to support a geospatial portal are detailed in the *Geospatial Portal Reference Architecture* [1]. Consideration should also be taking into account integration and interoperability with non-geospatial portal environments and associated standards.

A summary of core geospatial portal services [1] follows:

Portal Services – Provide the single point of access to the geospatial information on the portal. In addition, these services provide the management and administration of the portal.

Catalog Services – Used to locate geospatial services and information wherever it resides and to provide information to the user on the services and information found.

Portrayal Services – Used to process the geospatial information and prepare it for presentation to the user.

Data Services – Used to provide geospatial content and data processing, including but not limited to supporting digital rights management.

Table 13 – GEO Web Portal Requirements

Requirement
Shall provide a catalog client interface conformant with TBD to access the GEOSS Clearinghouse
Shall respond to TBD hits per/hour with less than TBD% degradation of performance vs. no-load performance.
Shall have a TBD interface to web pages hosted at the GEO Secretariat.
Graphical design of the Human-Computer Interface shall use the GEOSS identity design themes as identified in TBD.
Shall be hosted on a computer hosted at TBD. The hosting location shall provide access to the Internet.
Maintenance of the GEO Web Portal content shall be performed by TBD organization.

Maintenance of the software of GEO Web Portal shall be performed by TBD organization.
The clearinghouse shall be available at least 99% of the time, i.e., approximately 7 hours of down time a month.

GEO Logo can be download from this site:

from ftp://ftp.wmo.int/Projects/GEO/BRANDING/

Guidelines for using the Logo:

1. The GEO logo consists of a graphic representation of the acronym "GEO" and the text "GROUP ON EARTH OBSERVATIONS" and should be used as awhole.

2. The colours of the GEO logo should not be altered.

3. The font used in the text portion of the GEO logo (Frutiger LT Std45 Light) should not be altered.

If the GEO logo is needed in another format (JPG, GIF, etc) or size, contact Hermen M. Westerbeeke (hwesterbeeke@geosec.org)

5.4.2 Community Portals

(Section to be developed: community portals provide a user interface for a specific community. The user interface including the accessible information is tuned to the needs of the user community. User communities can be for a specific research interest, societal benefit area, ets.

The Pilot is seeking two types of respones regarding Community Portals:

1. Existing community portals that currently provide web access to a community of users. Participation in the Pilots will enable the participating organization to expand their portal by interoperating with additional web services. The Community Portals will also play a significant role in the demonstration of user scenarios.

2. Portal solutions are available for hosting by other organizations. Solutions will need to be freely distributed to any organization for hosting and populating by the receiving organization. Proposals should for portal solutions should not only describe what the portal can do but the methods by which other organizations can obtain and configure the portal solution at their sites.

5.4.3 Decision Support Clients

(Section to be developed: Decision support clients are applications that can access remote data using web services and provide manipulation of the data in the client application. Decision Support Clients may be specific to a User Community or may be a generic

geospatial data application. Clients which can be distributed free of charge are desired, note that this does not necessarily require that the code is open source.)

The Decision Support Client component type includes GEONETCast clients

5.5 Business Process Components

5.5.1 GEOSS Registries

A registry is an information system on which a register is maintained; whereas, a register is a set of files containing identifiers assigned to items with descriptions of the associated items (definitions from ISO 19135). A registry provides access to the registers that it maintains.

Assignment of registries to owners.

1. GEO Member & PO register - GEOSec

2. GEOSS components register - GEOSec (or Clearinghouse/portal host)

3. GEOSS Standards register - IEEE

4. GEOSS Special Arrangements register - IEEE

5. GEOSS Services register - for GEOSS-registered services

6. GEOSS Best Practices register, GEOSS Reusable components register, etc. - whoever wishes to offer them.

The GEOSS Clearinghouse will access all these registers and the GEOSS Portal will provide an interface for searching the information in all these registers.

IEEE plans to have it's own user interface to the Standards and Special Arrangements registers, but will be searchable by the Clearinghouse/Portal.

5.5.2 GEOSS Clearinghouse

The GEOSS Clearinghouse provides access to a distributed network of catalogue services that support the interoperability agreements of GEO. Member and participating organizations may nominate catalogues containing structured, standards-based metadata and other web services for access by the GEOSS Clearinghouse. The Clearinghouse provides search capability across the catalogues and their registered resources. The GEO Web Portal, the subject of another GEO Task, will search the GEOSS Clearinghouse but will also provide access to other GEOSS resources. Through the use of interoperability standards, additional portals may be established for national or professional communities to access the GEOSS Clearinghouse. The Global Spatial Data Infrastructure (GSDI), for example, offers a similar clearinghouse capacity.

The GEOSS Clearinghouse will cache some of the registers in GEO. The GEOSS Clearinghouse will cache portions of the GEOSS service register for the distributed

catalogue services made accessible by GEO Principals. The GEOSS Clearinghouse may also serve as a registry for other registers to be defined, e.g., documents, terminology, coordinate reference systems, codesets, models, etc.[xxix]

The GEOSS Clearinghouse context is defined in Figure 13

The GEOSS Clearinghouse enables a federation of catalogues. Each catalog shall maintain its own metadata registry. The Clearinghouse is not a central metadata registry. The Clearinghouse enables discovering communities.

A key consideration is that GEOSS catalogues data and services with sufficient metadata information so that users can find what they need and gain access as appropriate. [...] Users searching GEOSS catalogues will find descriptions of GEO Members and Participating Organizations and the components they support, leading directly to whatever information is needed to access the specific data or service in a harmonized way, independent of the specific provider. In this sense, the interoperable GEOSS catalogues form the foundation of a more general 'clearinghouse'. GEOSS data resources can be fully described in context, and data access can be facilitated through descriptions of other useful analysis tools, user guides, data policies, and services. Many examples of such clearinghouse facilities already exist in the realm of Earth Observation and networked information systems generally, and many of these already employ interoperable interfaces. [...][xxx]
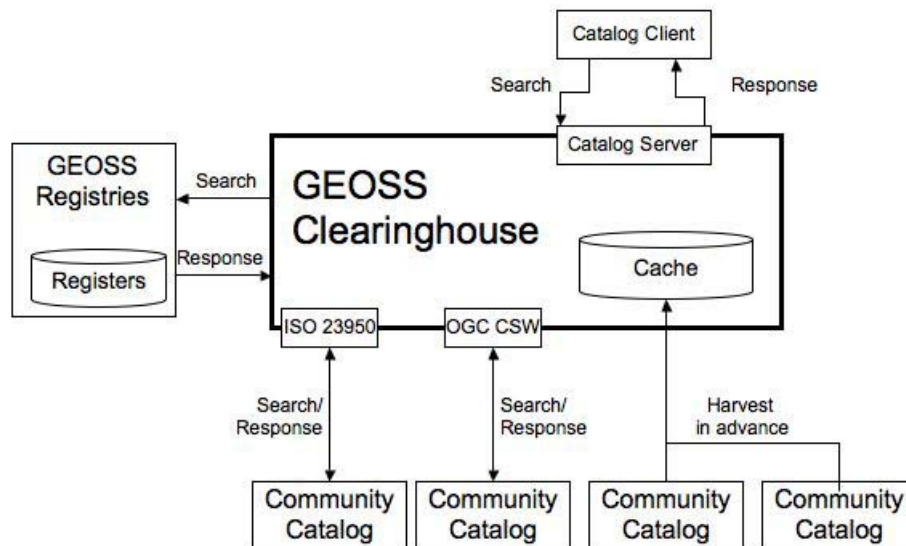
Figure 13 – GEOSS Clearinghouse Architecture - Engineering Viewpoint

Specific interoperability arrangements are provided by the GEOSS Clearinghouse to maximize the ability to function in a distributed environment. For catalogue services, the ISO 23950 (ANSI Z39.50) standard using the Geospatial Profile (GEO) may be offered. The OGC Catalogue Services Specification 2.0.1 includes references to the Z39.50 protocol binding as well as the Catalogue Services for the Web (CS-W) protocol binding, which may also be offered for search through the GEOSS Clearinghouse. Both ISO

23950 and CS-W catalogues are anticipated offerings for search by the GEOSS Clearinghouse. The anticipated metadata standards in use include the ISO 19115 and 19139 (XML) standards and the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM, 1998). ISO 15836:2003 (Dublin Core) as applied to geospatial information is to be considered. Additional metadata standards may be anticipated although they will require specialized programming to process the results of the distributed search.[xxxi]

The GEOSS Clearinghouse should anticipate the ability to perform distributed search of remote disparate catalogues and the ability to harvest and cache metadata from certain distributed collections. Some metadata collections may be highly static or are not available through web search services (only ftp or http web directories) are amenable to caching and search within the Clearinghouse. Other metadata collections are searchable through catalogue interfaces and may be searched in parallel through the GEOSS Clearinghouse interface. Both methodologies are sought for demonstration in the GEOSS Clearinghouse proof-of-concept.

The metadata to be held by the Clearinghouse is dependent upon the approach used for searching. Two anticipated capabilities for access to remote catalogues may include:

- Distributed search approach: search requests are sent in parallel to registered distributed catalogues. For these catalogues the only 'local' Clearinghouse metadata is the registered address for the distributed catalogue stored in the Service Registry.

- Harvested approach: The clearinghouse periodically harvests all metadata from registered distributed catalogues. A user search request is executed against the metadata harvested from the remote catalogues and the results are managed and portrayed in the Clearinghouse.

Table 14 – GEOSS Clearinghouse Requirements

Requirement
Shall provide a catalog service interface conformant with TBD
Shall provide catalog client interfaces conformant with • ISO 23950 (Profiles to be identified) • OGC Catalog Services for the Web (CSW) – (Profiles to be identified
Shall provide a registry for the following items • GEOSS Community Catalog Service metadata • (others)
Shall provide for registration of items in the Clearinghouse registers by the following methods: •

Shall have a TBD interface to other registries hosted at the GEO Secretariat.
Graphical design of the Human-Computer Interface shall use the GEOSS identity design themes as identified in TBD.
The clearinghouse shall be available at least 99% of the time, i.e., approximately 7 hours of down time a month.
Requirements for the future: Shall be hosted on a computer hosted at the GEO Secretariat. GEO Secretariat shall provide access to the Internet.
Requirements for the future: 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.
Requirements for the future: Maintenance of the software of Clearinghouse shall be performed by the contributing organization.

5.5.3 Community Catalogues

Each distributed community catalogue will hold metadata records that describe geospatial information and the means to access them. The metadata records shall be structured in accordance to standards agreed to by GEO. A given metadata record may represent a collection of imagery, an individual image, a vector data set or collection of features, a scanned map or other georeferenced information. Additional resource types that may be described in metadata include documents (e.g. spreadsheets, text files, HTML files), schemas, feature catalogues or data dictionaries, or other resource types of interest. Each metadata record should include a web-accessible link to the resource being described, though it may simply include instructions for other means of access. Where standards-based web access methods are available to visualize or access a data set, these should be expressed and included in the metadata record.

5.5.4 Search performance

Another area where GEOSS should be concerned about interoperablility is the ability to rapidly perform geospatial searches--on the order of many hundreds of bounding box searches per second. There has been some discussion of this "geospatial search accelerator" problem (see http://www.search.gov/geospatial for instance). Such scalability issues may also lead into research on generalized approaches to distributed geospatial database architectures.

5.5.5 Portrayal Services

Portrayal is the presentation of information for human visualization. For example, map portrayal is concerned with the shape and color of symbols representing features or is concerned with rules for displaying text labels or for showing or not showing symbols. A Portrayal Service produces visual pictures from geographic data. Portrayal Services are components that, given one or more inputs, produce rendered outputs such as

cartographically portrayed maps or perspective views of terrain.
Example implementations include: Web Map Service (WMS), Coverage Portrayal
Services (CPS) and Feature Portrayal Services (FPS). An FPS is a specialised
component-WMS able to portray GML data from WFS services. An CPS is a specialised
component-WMS able to portray coverage data from WCS services.

5.5.6 Processing Services

(To be defined, see for example the FedEO Pilot section.)

5.5.7 Workflow Management

(To be defined, see for example the FedEO Pilot section.)

5.5.8 Other Services

(To be defined as needed)

5.6 Data Access Components

5.6.1 GEONETCast

(get description of GEONETCast)

Services and content registered in catalogs to support discovery.

5.6.2 Observation Access Services

Services to access Earth Observation data.

EO data as features, coverages, and observations

Data access services, e.g., WMS, WFS, WCS, SOS, other

Services and content registered in catalogs to support discovery.

5.6.3 Model Access Services

Services to access Earth Observation Model predictions.

EO model outputs as features, coverages, and observations

Data access services, e.g., WMS, WFS, WCS, SOS, other

Services and content registered in catalogs to support discovery.

5.6.4 Other Services

(To be defined as needed)

Architecture Implementation Pilot CFP – Annex B – Initial Architecture

5.7 EO Data Encoding Formats

Systems interoperating in GEOSS agree to avoid non-standard data syntaxes in favor of well-known and precisely defined syntaxes for data traversing system interfaces. The international standard ASN.1 (Abstract Syntax Notation) and the industry standard XML (Extensible Markup Language) are examples of robust and generalized data syntaxes, and these are themselves inter-convertible[xxxii].

Summary Table of relevant formats including identification of the abstract information types encoded by the formats

6 Technology Viewpoint – Component Instances

The Technology Viewpoint defines the component and service instances that comprise the "as-built" system. A purpose of the Pilot Development process is to identify the component instances. The Technology Viewpoint will be populated in the version of this architecture at the conclusion of the Pilots.

7 Pilot-Specific Background Information

7.1 GEO ADC Definitions

The following Candidate GEOSS Architecture-related Definitions were compiled during GEO ADC meeting, December 2006.

GEO (Group on Earth Observations): GEO is an intergovernmental partnership among GEO Member countries and Participating Organizations: see http://earthobservations.org/

GEO Member: Any member State of the United Nations may become a GEO Member on request and after having endorsed the GEOSS 10-Year Implementation Plan.

GEO Participating Organization: Subject to approval by GEO Members, any intergovernmental, international, or regional organization with a mandate in Earth observation or related activities may become a GEO Participating Organization on request and after having endorsed the GEOSS 10-Year Implementation Plan.

GEOSS (Global Earth Observation System of Systems): The collection of collaborating earth observation systems that are registered with the GEO to provide access to diverse, multi-disciplinary data and services associated with earth observation. GEOSS reflects a global scientific and political consensus that information vital for societies requires comprehensive, coordinated, and sustained Earth observations.

GEOSS 10 Year Implementation Plan: The GEOSS 10 Year Implementation Plan is directed by GEO (Group on Earth Observations) to achieve the vision of comprehensive, coordinated, and sustained Earth observations for the benefit of societies worldwide.

component: a part of GEOSS contributed by a GEO Member or Participating organization. Example types of components include observing systems, data processing systems, dissemination systems, educational programmes, or other initiatives. Components may expose *service* interfaces to provide access to earth observation-related functions and/or data. Components are described in the *GEOSS Component Registry*.

service: Functionality provided by a component through component system interfaces. Services communicate primarily using structured messages, based on the Services Oriented Architecture view of complex systems. Services are described, along with information about their operating organizations, in the *GEOSS Service Registry*.

Services Oriented Architecture [get official website] OASIS, W3C

interoperability: the ability to link two or more components/services to execute a particular task that spans those components without knowledge of underlying implementation. Interoperability may be addressed at the component level and/or defined at the service interface level through the adoption of common standards.

interoperability arrangement: a registered declaration by one or more GEO Members or Participating Organizations to provide access to *services* and data through identified non-proprietary standards. Formal international standards are documented and referenced in the Standards Registry. Interoperability arrangements that document informal

standards are referenced in the Special Arrangements Registry. Special arrangements are not required when referencing formal international standards starting from those in the Standards Registry.

standard: documented approach for conducting an activity or task. Standards may be de jure (formally recognized) or de facto (informally adopted) within a community of application. De jure standards are typically managed by a standards development organization. Formal international standards are documented and referenced in the *Standards Registry*. Interoperability arrangements that document informal standards are referenced in the *Special Arrangements Registry*.

GEOSS Clearinghouse: a component that provides access to a network of catalogues and registries that conform to identified catalogue service and metadata standards. The Clearinghouse supports access to data, documents, services, and other resources through the search of descriptive properties (metadata) offered by GEO Members and Participating Organizations.

GEO Web Portal: a website that provides access through *standard* interfaces to the *GEOSS Clearinghouse*, GEOSS registries, and related information.

register: set of files containing identifiers assigned to items with descriptions of the associated items (ISO 19135)

registry: information system on which a register is maintained [and accessed] (ISO 19135)

7.2 GEOSS Clearinghouse RFI Results

One of GEOSS Architecture core tasks, the GEOSS Clearinghouse Task Team (AR-06-05), released a Request for Information (RFI) for the Proof of Concept phase of the GEOSS Clearinghouse to GEO Members and Participating Organizations. Objectives of the RFI

- Solicit comments on a draft architecture for the GEOSS Clearinghouse

- Invites GEO Members and Participating Organizations to contribute components for a Proof of Concept phase during 2007

The Clearinghouse is an important part of the dissemination portion of GEOSS. For accessing data in each diverse contributing system, the clearinghouse will be publicly accessible built upon a network-distributed approach, subject to GEOSS interoperability specifications.

RFI Contents included: GEOSS Clearinghouse Requirements, GEOSS Clearinghouse Architecture, and Proof of Concept Plan

The following members of GEO Task AR-06-05 prepared the GEOSS Clearinghouse RFI: OGC, USA, EC/JRC, Germany, IEEE, WMO, GEO Secretariat, ESA, Australia

The RFI is available here:
http://www.earthobservations.org/docs/RFI_GEOSS_Clearinghouse_13.10.2006.pdf

Error! Reference source not found. lists those organizations that responded to the Clearinghouse RFI and indicates if the response provided comments on the architecture and if the response offered specific components for the Proof of Concept Phase.

Table 15 – Clearinghouse RFI Responses

Responding Organization	Comments on Architecture	Components offered
BNSC/Infoterra	Yes	Web Map Service (WMS)
Canada/GeoConnections	Yes	GeoConnections Discovery Portal
EC/JRC	Yes	INSPIRE EU Geoportal Catalogue
ESA	Yes	EO-Portal ESA Service Support Environment ADEN/AADN ALOS Interoperability [Question : What kind of interoperability does this mean?]
GEONETCast	-	GEONETCast metadata
Germany	Yes	Geoportal Bund
IGOS-Geohazards	-	IGOS GeoHazards Catalogue
Japan/JAXA/Univ. Tokyo	-	Univ. Tokyo prototype system for metadata document registry JAXA Metadata Catalogue
UNGIWG/FAO/UNEP	Yes	(yes)
US/FGDC/USGS/IEEE	-	SOA Registry Clearinghouse gateway
US/NASA	Yes	Earth Science Gateway (ESG)

7.3 FedEO Architecture

The FedEO architecture is designed and describe below making use of the RM-ODP model[1].

The RM-ODP has been modified to take into account the objective of FedEO architecture and has been so tailored by replacing the computational viewpoint with a service viewpoint as detailed in the following paragraphs.

7.3.1 Enterprise Viewpoint

The enterprise viewpoint of FedEO is concerned with the business activities of the subject federated earth observation environment for example the SSE (Service Support Environment). These activities can be represented by two sets of use cases related to respectively the end-user of services and the service provider (or service owner).

- End-users benefit from this environment as it brings together distributed EO products and EO data offered by multiple service providers. Via this access points (accessible from distributed Web Portals or from service registries or catalogues), the end-user can more easily discover services matching his exact requirements. This discovery is facilitated by the thematic and local distribution of FedEO Services. EO product, data collection and service catalogues for multiple missions of different satellite operators are offered within a distributed environment and are linked with data access, programming, ordering and processing services hereby offering a one-stop solution for users of EO services.

- The environment empowers service providers by offering them the possibility to advertise and integrate their new and existing services within thus one stop Portals for EO data and EO products. Their simple or chained services would be promoted and provided to different level (local and thematic) Portals depending on the characteristic of the services. The distributed portals are provided with cost-effective tools based on open standards allowing them to publish and manage their services as well as monitor their use whilst keeping control over the services backend on their local infrastructure. These services can be combined with other services that may possibly be provided by third parties hereby facilitating the definition of advanced value-adding products on EO imagery by distributing the processing steps over different specialists. Service providers can offer these services via the Portals pages or via a machine-to-machine "data access integration layer" allowing discovery of their services via a virtual service and data/products registry or catalogue.

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[1] "Reference Model of Open Distributed Processing", ISO/IEC 10746-1:1998, 1998
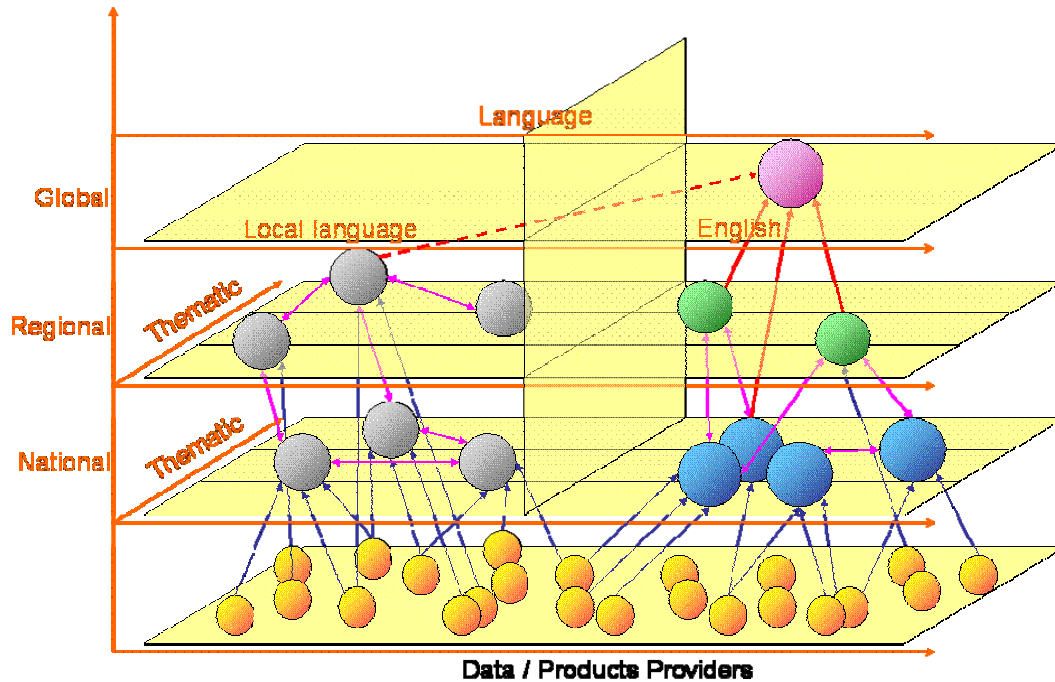
Figure 14 - Portals distributed network

The **enterprise viewpoint** thus addresses following high level objectives:

- provide a neutrally managed overarching distributed infrastructure enabling the interactions among products and data providers, service providers and with end-users,

- permit service interaction whilst avoiding the service de-localisation (i.e. services remain on the service provider infrastructure),

- allow easy publishing and orchestration of synchronous and asynchronous EO services for online and offline processes,

- allow chaining of services into more complex ones,

- support "subscription" type services and standing orders (e.g. fires active monitoring and alerting),

- support the evolution and maintenance of services, integrating the HMA Testbed and conformance testing environment as an integral part of the FedEO Portal.

- allow easy identification of, and access to requested services and products, with progress follow-up until completion,

- integrate services from multiple domains, e.g. geospatial, meteorological, in-situ, to exploit multi-domain synergies,

- allow services/data providers to register, provide and promote their products to thematic or local portals,

- minimise service provider investments by building on open standards.

The objective of this FedEO architecture is to demonstrate the benefits of the protocols proposed in the technological view below with multiple scenarios. This will allow the services to be deployed as depicted in the following Figure 14 : global, regional and national with thematic scales.

The following services will be involved in the FedEO architecture:

- Collection and service catalogue discovery,

- Catalogue search service,

- Satellite Programming and Product Order,

- Online Data Access,

- Satellite Multicast Service,

- Orthorectification and re-projection services,

- Service Orchestration

7.3.2 Information Viewpoint

The **information viewpoint** specifies the modeling of all categories of information that the proposed architecture deals with, including their thematic, spatial temporal characteristics as well as their metadata.

In the FedEO architecture, oriented towards geospatial services, one of the main information categories relates to the descriptions or metadata of these services. This service metadata needs to provide the details to allow for machine-to-machine communications but also contain descriptive information targeted at human readers. This service metadata can be modeled according to ISO 19119, as shown in the following figure. Each service may be defined by:

- Identifying properties (type of service, title, abstract, contact information, usage restrictions, region/time period of applicability…)

- Operations (e.g GetCapabilities, GetMap, GetFeasibility, SubmitOrder ... with their connection points and protocol bindings)

- Coupling of operations to data metadata and the type of this coupling (loose, tight or mixed)
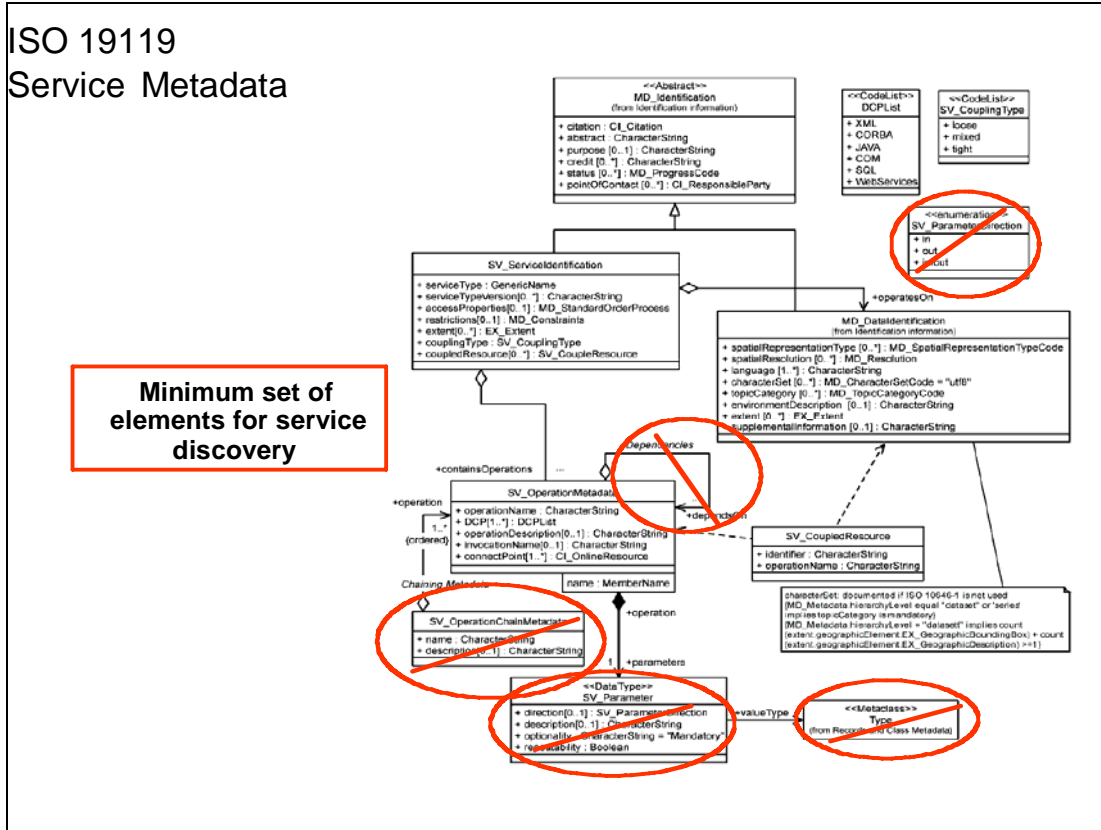
Figure 15 - ISO 19119 Service Metadata

This ISO 19119 defines the model for geographic services metadata, it however does not cater for the XML encodings of these. This is dealt with in the ISO 19139 specification that describes the transformation of the abstract UML models into XML schema.

This ISO 19139 standard also is used for the XML encoding of EO Collection metadata, another important category of information within our architecture. EO collections are described in accordance with the ISO 19115 model for geographic metadata.

However the most important information model in a geospatial service digital library is the one of the EO Product metadata which has been based on Open Geospatial Consortium - OGC's Geography Mark-Up Language - GML and where the modularity vis-à-vis the different types of missions or sensors

It has been achieved by defining different application schemas (for optical i.e. OHR, radar, i.e. SAR, atmospheric, i.e. ATM) that are extending the underlying schemas as described in the following figure.
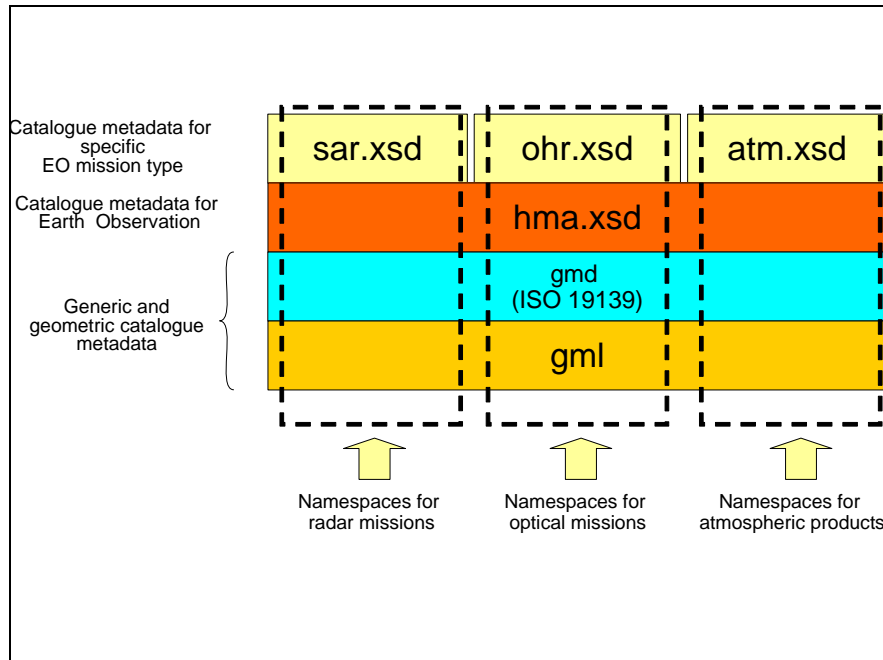
Figure 16 - GML Application Schemas for EO

Thematic instances of the SSE, e.g. an SSE dedicated to marine-related services, may also use emerging semantic Web technology to facilitate the modeling and interlinking of information. It is envisaged to use W3C Resource Description Framework - RDF and OWL – Web Ontology Language to enable end-users to more easily identify and locate services related to their domain, e.g. algae bloom, oil spill etc. by interlinking the services with agreed ontologies and controlled domain vocabularies or thesauri.

7.3.3 Service Viewpoint

The **Computational Viewpoint** in the RM-ODP is replaced within the proposed architecture by the **Service Viewpoint**. It specifies the services that support the syntactical and semantic interoperability between the *high-level operational services* waited for the FedEO pilot. The FedEO's service oriented architecture shall place no restrictions on the granularity of a geospatial (Web) service that can be integrated. The grain size can range from small (for example a component that must be combined with others to create a complete business process) to large (for example an application). It is envisaged to support two main categories of services:

- *Basic services* are limited services running on the service providers' local infrastructure. Basic services may be requested (ordered) via the Portal's user interface, or from within a composite service (or workflow).

- *Composite services* are services consisting of a combination of basic services or other composite services provided by one or many different service providers.

Another way of dividing services into categories relates to the specific functions performed by the service. The following set of specific EO data access services has been defined firstly in the scope of the GMES Program but are extended for the FedEO Pilot :

- Collection and service discovery (CSW)

- Catalogue Service (CSW)

- Product Programming and Order (SPS)

- Online Data Access (WxS)

- Satellite Multicast Service

- Service Orchestration

- Processing Services

- Orthorectification and re-projection services (WCTS)

1) **Collection and Service Discovery**

An end-user typically uses *collection discovery* to locate dataset collections meeting the needs of his application domain e.g. urban planning, precision farming etc. The *service discovery* service then provides access to the services that operate on these dataset collections, e.g. catalogue, ordering, data access or programming services.

2) **Catalogue Service**

The *catalogue service* allows a user to find datasets or products within a discovered dataset collection that meet specific search criteria such as time, geographic extent, cloud cover, snow cover, polarization etc. and gives access to all dataset metadata available in a catalogue. As explained within the information viewpoint, these product metadata vary depending on the type of mission: optical, radar or atmospheric.

3) **Satellite Programming**

A user can request the feasibility for acquiring and order future products for data not yet in the catalogue (resulting in the eventual satellite programming)– by using the programming service.

4) **Product Order**

A user accesses the ordering service to order datasets referenced from within the (distributed) catalogue service for delivery of the product either online or via media.

5) **Online Data Access**

Various on-line data access services provide access to ordered datasets via the Internet. Such services typically use the File Transfer Protocol – FTP for allowing access to EO data, but also more advanced methods such as OGC Web Services for data delivery and visualization: Web Coverage Services – WCS, Web Feature Services –WFS and Web Map Services -WMS.

6) **Satellite Multicast Service**

Eumetsat uses the satellite multicast service (Eumetcast) as the primary dissemination mechanism for meteorological data.

The ESA Data Dissemination Service - DDS is meant for data circulation in the ESA Ground Segment. Its spare capacity is used by the SSE to multicast SSE service results to remote end-users in Africa using Eutelsat's C-band and the Ku band in Europe.

7) **Identity (user) management**

Access by the following types of users is envisaged:

• Anonymous users can activate services for which the service provider does not require user information.

• Registered users can activate services for which the service provider has not restricted access.

• Data, Products and Service providers, can in addition publish services and deploy composite services implemented as workflows as well as monitor the execution of these services via a console. A service provider can also specify his service to be access-restricted and thereby only allow specific registered users to access his service.

• The Administrator performs the administration of the system and can assign service provider rights to a user.

8) **Service Orchestration**

Service orchestration based on the OASIS Business Process Execution Language – BPEL[2], allows for composition of Web services, typically from multiple service providers or ground segments which themselves become then available as Web services. The orchestration engine is the service used to execute the resulting composite services.

9) **Processing Services**

Extensive tests have been performed as well within the ESA Grid infrastructure leading to a preliminary definition of a Grid-based Processing Service. This with the objective of reducing the burden caused by the transfer of large EO coverages by transferring instead the processing algorithms on the Grid that hosts within its storage element the coverages to be processed.

The OGC Web Coordinate Transformation Service – WCTS is another processing service that was experimented with, in combination with a Spot Image Web Coverage Service as described within the OGC OWS-3 Imagery Workflow Experiments.

10) **Orthorectification and re-projection services**

Ortho-rectification an re-projection of remote sensing images is an important issue for various applications. Indeed, the image orthorectification an re-projection process combines relief effects corrections and geo-referencing with high location accuracy.

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[2] "Web Services Business Process Execution Language Version 2.0", OASIS Committee Draft, 2005-12-21

7.3.4 Engineering Viewpoint

It specifies the mapping of the service specifications and information models to the chosen service and information infrastructure. The FedEO server at ESA is based on the Service Support Environment (SSE) ones which provide a reusable architecture for the integration of services in the Earth Observation (EO) and geospatial domains.

The SSE server architecture is outside the scope of this architecture document, details are available at http://services.eoportal.org

7.3.5 Technology Viewpoint and Standards

This point of view specifies the technological choices and the standards selected for the FedEO architecture and the operational issues of its infrastructure. For example Basic Services are connected over the Internet as Web services, using the Simple Object Access Protocol -SOAP, the Web Service Description Language - WSDL and FTP for large data flows. These 3 specifications are supported by the World Wide Web Consortium – W3C (www.w3c.org).

1) Service Discovery

The OGC CS-W 2.0.1 ISO Metadata Application Profile[3] will be used for service discovery. This application profile of the Catalog Services for the Web - CS-W specification provides ISO 19139 compatible XML Schema for Catalog Search Result sets for ISO 19115 (data) and ISO 19119 (service) metadata. In addition, it defines the available operations and the supported query criteria (queryables) that catalog clients can use for interacting with the catalog service. It enables users to discover and retrieve metadata about available Earth Observation related services hereby providing sufficient information to assess the usefulness of a service for the task at hand. Furthermore, it offers the binding information for accessing this service (e.g. HTTP binding together with a hyperlink composed of a GetCapabilities request of an OGC Web Service - OWS (WMS, WCS, WFS). In addition, FedEO can support service discovery via Universal Description, Discovery and Integration – UDDI[4] from OASIS with the advantage of allowing mainstream IT tools from large vendors (Oracle, IBM, Microsoft) to discover the exposed services.

2) Collection Discovery Service

As for the discovery of services, the OGC CS-W 2.0.1 ISO Metadata Application Profile will be used for the discovery of EO product collections of which the metadata is encoded within an ISO 19115 and ISO 19139 based model and encoding. As a consequence existing COTS and Open Source tools as FAO's "GeoNetwork Opensource" catalogue solution can for instance be used for storing and discovering dataset collection metadata as well as the associated services.

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[3] U. Vogues and K. Senkler, "OpenGIS Catalogue Services Specification 2.0.1 (with Corrigendum) - ISO Metadata Application Profile", Version 1.0, OGC 04-038r4, 2006-03-23
[4] "Universal Description, Discovery and Integration (UDDI) v2.0",OASIS standard set, 2002-08

Further Note:

An ebRIM extension package for the ISO 19115/19119 metadata are is also being developed and should be available as a discussion paper after April, this is a strong candidate for replacement of the CSW ISO profile. This profile may be further tested within the scope of the FEDEO pilot.

3) Catalogue Service

For the « dataset » (product) catalogue service the CS-W Application Profile for Earth Observation[5] was initially proposed to take into account the EO specific product metadata.

Since then, we have migrated to the ebRIM Application Profile of CS-W as this allows using an application profile that is also in use outside the EO domain. This is in-line with the recent OGC decision to recommend the use of the ebRIM model as information model for future catalogue specifications. The ebRIM information model for EO data is defined in the EO extension package for ebRIM Profile of CSW2.0[6].

In both cases, the metadata are specified as a GML application schema defined within OGC 06-080[7].

4) Programming and Ordering Services

The SSE provides interfaces to access programming and ordering services for EO products. The programming interface constitutes an EO profile of the OGC Sensor Planning Service - SPS. The ordering service interfaces are defined in the Ordering Services for Earth Observation Products paper[8].

5) Online Data Access

The following set of geospatial services defined by the OGC will be used for user interaction and/or data access and information visualization:

- Web Map Service – WMS[9] : This OGC implementation specification (and ISO standard) defines the interactions between client and server applications for the delivery of maps, rendered geographic information, over HTTP. Within the proposed architecture, this standard is employed for both supplying background maps and for visualizing outputs of services. For example, browse images of EO products can be visualised during catalog searches by employing a profile of this protocol.[10]..

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[5] Y. Coene and M. Gilles, "OpenGIS CSW Application Profile for Earth Observation", Version 0.1.8, OGC 06-079r2, 2006-08-25
[6] R. Primavera, "EO Products Extension Package for ebRIM (ISO/TS 15000-3) Profile of CSW 2.0", Version 0.0.3, OGC 06-131, 2006-10-24
[7] J. Gasperi, "GML 3.1.1 Application schema for Earth Observation products", Version 0.1.4, OGC 06-080r1, 2006-11-24
[8] D. Marchioni, "Ordering services for Earth Observation Products", Version 1.1.0 Draft, OGC 06-141, 2006-11-24.
[9] J. de La Beaujardière, "OpenGIS Web Map Service Implementation Specification", Version 1.1.1, OGC 01-068r3, 2002-01-16

[10] Thomas H.G. Lankester OGC 06-093, "OpenGIS® Web Map Services -Application Profile for EO Products" Version: 0.1.0 Discussion Paper

- Web Feature Service – WFS[11] : Another OGC implementation specification (and ISO standard) that deals with the remote querying and updating of geographical data stores over the Web. It is employed as the protocol that allows end-users to query geographical referenced service results. For example, the results of an EO imagery processing service that determines geographic features (e.g. Bush fires, oil spills, land cover objects, …) from satellite images can be stored inside a WFS data store and then interactively be interrogated by end users of these services. Transactional Web Feature Services are being evaluated as a means for capturing geographic feature edits. Also the use of the gazetteer service profile of this specification is being investigated to allow the remote interrogation of gazetteers, geographical dictionaries of place names and their corresponding coordinates.

- Web Coverage Service – WCS [12]: The OGC implementation specification related to the delivery of coverage, in casu raster data files, across the Internet. It is used as the interface by which clients can download and visualize EO products.

6) Service Orchestration

The workflow engine is the component executing the workflows within a Service-Oriented Architecture. It executes business processes based on the Business Process Execution Language for Web Services - BPEL standard.

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[11] P. Vretanos, "OpenGIS Web Feature Service Implementation Specification", Version 1.1.0, OGC 04-094, 2005-05-03

[12] J. Evans, "OpenGIS Web Coverage Service Implementation Specification", Version 1.0.0, OGC 03-065, 2003-08-27

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[i] **United Nations Spatial Data Infrastructure**: Vision, Implementation Strategy and Reference Architecture, DRAFT DISCUSSION PAPER, October 2006 (referenced in RFI Response from Mick Wilson, UNEP, 28 December 2006)

[ii] ADC references as identified in ADC telecon 31 Jan 07

[iii] **GEOSS Strategic Guidance Document**, GEO Task Team AR-06-02, 14 December 2006

[iv] **GEOSS Strategic Guidance Document**, GEO Task Team AR-06-02, 14 December 2006

[v] **GEOSS Strategic Guidance Document**, GEO Task Team AR-06-02, 14 December 2006

[vi] **GEOSS Strategic Guidance Document**, GEO Task Team AR-06-02, 14 December 2006

[vii] **GEOSS Strategic Guidance Document**, GEO Task Team AR-06-02, 14 December 2006

[viii] **United Nations Spatial Data Infrastructure**: Vision, Implementation Strategy and Reference Architecture, DRAFT DISCUSSION PAPER, October 2006 (referenced in RFI Response from Mick Wilson, UNEP, 28 December 2006)

[ix] **United Nations Spatial Data Infrastructure**: Vision, Implementation Strategy and Reference Architecture, DRAFT DISCUSSION PAPER, October 2006 (referenced in RFI Response from Mick Wilson, UNEP, 28 December 2006)

[x] **GEOSS Strategic Guidance Document**, GEO Task Team AR-06-02, 14 December 2006

[xi] **GEOSS Components Registration,** GEO Task Team AR-06-04, 26 January 2007.

[xii] **GEOSS Components Registration,** GEO Task Team AR-06-04, 26 January 2007.

[xiii] **United Nations Spatial Data Infrastructure**: Vision, Implementation Strategy and Reference Architecture, DRAFT DISCUSSION PAPER, October 2006 (referenced in RFI Response from Mick Wilson, UNEP, 28 December 2006)

[xiv] (Need to reference the relevant ISO standards.)

[xv] This section contains an excerpts from the "Guideline for Basic Geographic Data," developed by GEO Task DA-06-05, Draft Ver2.

[xvi] **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.

[xvii] **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.

xviii **Response to the GEOSS Clearinghouse RFI,** Ioannis Kanellopoulos, European Commission, DG Joint Research Centre, October 2006

xix **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.

xx **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.

xxi **United Nations Spatial Data Infrastructure**: Vision, Implementation Strategy and Reference Architecture, DRAFT DISCUSSION PAPER, October 2006 (referenced in RFI Response from Mick Wilson, UNEP, 28 December 2006)

xxii **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.

xxiii **Response to the GEOSS Clearinghouse RFI,** Ioannis Kanellopoulos, European Commission, DG Joint Research Centre, October 2006

xxiv Summary of SRW was provided by Eliot Christian.

xxv http://www.opengeospatial.org/standards/cat

xxvi **Response to the GEOSS Clearinghouse RFI,** Myra Bambacus, NASA, January 2007

xxvii **Response to the GEOSS Clearinghouse RFI,** ESA-HMA, January 2007

xxviii **GEOSS Components Registration,** GEO Task Team AR-06-04, 26 January 2007.

xxix **GEOSS Clearinghouse RFI**, GEO Task Team AR-06-05, October 2006

xxx **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.

xxxi **GEOSS Clearinghouse RFI**, GEO Task Team AR-06-05, October 2006

xxxii **GEOSS 10-Year Implementation Plan Reference Document**, Section 5, "Architecture of a System of Systems", February 2005.