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GEOSS AIP And GEOSS Water Services

Bart de Lathouwer

Douglas Cripe

David K. Arctur

David R. Maidment

GEOSS AIP AND GEOSS WATER SERVICES

DE LATHOUWER, BART (1); CRIPE, DOUGLAS (2); ARCTUR, DAVID (1, 3); MAIDMENT, DAVID (3)
(1): Open Geospatial Consortium (OGC), USA
(2): Group on Earth Observations (GEO) Secretariat, Geneva, Switzerland
(3): Center for Integrated Earth System Science, University of Texas at Austin, USA

The Global Earth Observation System of Systems (GEOSS) is being built through the coordination of efforts within the international Group on Earth Observations (GEO), a voluntary partnership established in February 2005, comprised of 89 Member States, the European Commission and 77 Participating Organizations. GEOSS is a global, distributed system accessible through the GEOSS Portal, including satellite observation systems and *in situ* networks and systems, which will deliver the benefits of Earth observations to both data & information providers and consumers world wide. The 10-Year Implementation Plan defines a vision statement for GEOSS, its purpose and scope, expected benefits for nine "Societal Benefit Areas" (SBAs) (disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity), technical and capacity building priorities, and the GEO governance structure. [1] The GEOSS Architecture Implementation Pilot (AIP) develops and deploys new process and infrastructure components for the GEOSS Common Infrastructure (GCI) as well as for the broader GEOSS architecture. The requirements for AIPs are based on user needs and community scenario requirements. The AIP process aims to increase the use of GEOSS resources by end-users in applying both *in situ* and remotely sensed data, and by extending results from previous GEO developments through integration with the GEOSS Common Infrastructure (GCI).

AIP DEVELOPMENT PROCESS

Process Overview

The AIP employs an evolutionary development process whereby the architecture, the delivered systems, and the stakeholders co-evolve. Stakeholder needs are reassessed in each iteration of the architecture; the architecture is used to guide each system as it moves through development, and appropriate versions are used to evaluate each system on delivery. Architectures developed under this approach emphasize flexibility and adaptability. This approach is well suited to software system development where it is impossible to postulate all of the requirements and the system development can proceed iteratively. The AIP Development process consists of a series of phases, e.g., phase 7 (AIP-7).

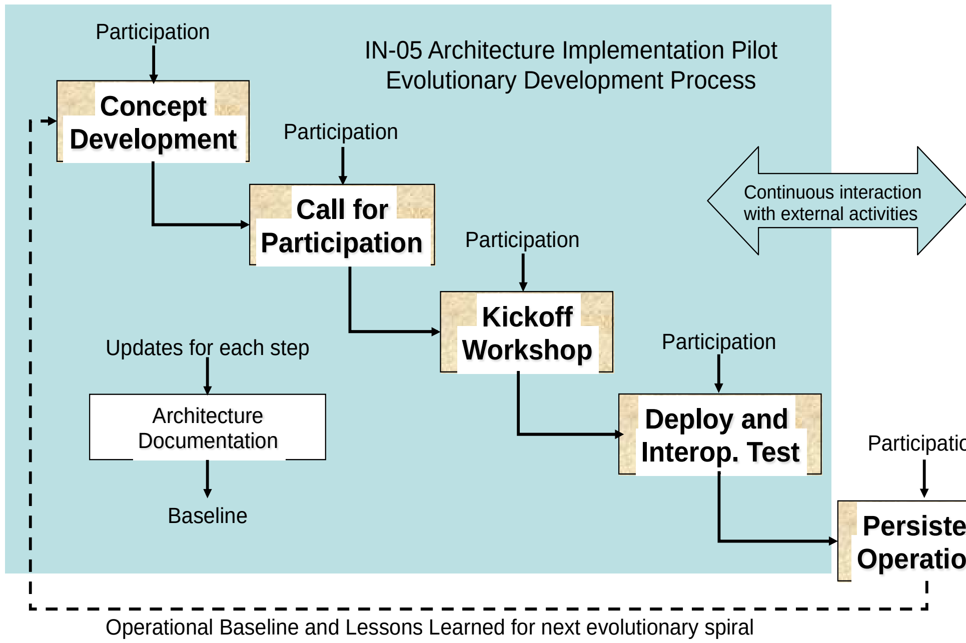

Figure 1 – AIP Development Approach

Concept Development
The Concept Development phase produces an architecture and plan sufficient for a Call for Participation (CFP) in the Pilot Initiative. The Architecture is refined based upon the results of previous phases of the Pilot. This feedback is a key to this form of evolutionary development process. The next step in the AIP development process is to release the CFP, and to receive and evaluate responses. Once a draft CFP is developed by the AIP Team it is presented to the GEO Infrastructure Implementation Board (IIB) for their review and comment. Comments are addressed and incorporated by AIP IP Team into the final version of the CFP. Once the AIP Team and IIB agreed to the release, the CFP is announced through several communication mechanisms, in particular by the GEO Secretariat. The desire is that multiple organizations will respond to the CFP explaining the technical contribution they intend to make, how their contribution maps to the architecture, and the contributions they will make to the initiatives. On receipt of the CFP responses, the AIP IP Team reviews the responses, updates the architecture and plans for the Kickoff Workshop.

Kickoff Workshop
Organizations that respond to the CFP attend the Kickoff Workshop (usually held in the 1st quarter). During Kickoff workshop, a development plan and schedule that define specific milestones will be confirmed. The Kickoff Workshop addresses: (1) component definition and (2) scenario development. These development activities interact and affect each other.

At the Kickoff Workshop, there are meetings to begin developing component solutions. This allows the participants to meet in-person or virtual to plan the pilot as all subsequent activities are conducted using distributed communication mechanisms. The participants are expected to have systems and/or software engineers in attendance to assist in the initial assessment and interaction of Interoperability Arrangements. Use cases are developed for organizations to consider in their component design. As a way of validating the use cases and interoperability arrangement, they are analytically “exercised” against the scenarios.

Simultaneously at the Kickoff Workshop, there are breakouts to begin scenario design and creation. This activity involves the development of use cases to implement the scenarios. Discussion of needed data and coordination with involved communities will be needed to ensure the validity of the scenario development. A result of the Kickoff Workshop is establishment of Working Groups (WGs) for SBA and technical topics. Volunteers to lead the WGs are determined.

Design, Deploy and Interoperability Testing

Deployment and Interoperability Testing begins after the Kickoff Workshop and includes the elements of System Design, Component Deployment and Testing activities. Development activities occur in both WG and Plenary groups.

Using results of the Kickoff Workshop as the governing documents for the conduct of the initiative, the participants 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 persistent, operational exemplar components and demonstrations exercising the components to meet the needs of the SBAs.

The System Design process is structured using Scenarios and Use Cases. Scenarios describe how GEOSS is envisioned to support the SBAs. Use Cases are reusable transverse technology approaches for implementing the scenarios. Results of the Design Process include identification of Interoperability Arrangements for components and services that will achieve the objectives of the SBA scenarios and broader architecture.

During the selection of Interoperability Arrangements, modifications to existing open standards specifications may be found to be necessary, in which case a change proposal must be developed that documents the change. Change proposals do 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 the appropriate standards developing organization (SDO).

Participants can interact with the GEOSS Standards and Interoperability Forum (SIF). The SIF oversees the Standards and Interoperability Registry (SIR). SIF Interoperability Advisors provide technical assistance with questions and decisions regarding interoperability, including use of standards and special arrangements. SIF representatives participate in the AIP process. Online access to the SIF can be found by going to http://seabass.ieee.org/groups/geoss.

Use of the Best Practice Wiki (BPW) is encouraged for AIP participants so that what is believed to be a best practice can be recorded for others to benefit from as they decide to participate in GEOSS. Contributions to the BPW need not be finished best practices, since the BPW can be used during the AIP process to fine-tune the content provided.

A primary goal of a pilot is to verify by testing that interaction of a set of components that exercise a set of specifications supports SBA scenarios. AIP Testing is tailored to the specific environment of GEOSS considering that there is not a separate testing team. Testing is done at two levels: 1) unit testing of individual services as defined in engineering use cases, and 2) integrated testing of SBA scenarios. Testing is organized around two iterations of unit testing followed by a single scenario testing. Interoperability testing has been recognized as a much needed and useful activity that produced extremely valuable results, with the issue of versioning of services and interfaces experienced in many situations.

Demonstration

Demonstrations within the AIP communicate to the GEO community new capabilities developed in the Phase that can be considered for GEOSS enhancements. Some demonstrations do not necessarily result in changes to GEOSS, but show new results based on GEOSS components, data, and services.

Participation in the demonstrations is predicated upon full engagement with development, testing, and planning activities throughout the initiative. To finalize the demonstrations, a Demo

Capture Workshop may be convened to conduct the final integration of the components and to refine the steps in the demonstrations. During the workshop, the demonstrations will be captured through techniques such as client screen capture software. The demonstrations will then be made available for distribution.

Demonstration developers coordinate on the production of the demo videos. Each of the videos is developed based upon a template common to all videos and a storyboard specific to each demo. Videos of the demo are captured and edited with desktop video tools. The complete set of demonstration videos will be packaged with an overall menu and introduction to AIP and made available on the web. In order to reach the broadest audience, demonstrations are made available via the Internet.

Transition to operations

GEOSS Operations are the responsibility of the GEO Members and Participating Organizations. Developments accomplished during an AIP Phase are anticipated to persist as through registration in the GEOSS registry ideally with the status of “Continuous Operations.” AIP provides an increase in the baseline of operational components in GEOSS and provides methods to monitor the operations of GEOSS components. AIP does not include the operations of GEOSS.

At the end of an AIP Phase, the results are communicated to GEO broadly with encouragement that the GEO maintain the results achieved. These presentations will inform the various groups of the AIP developments and new functionality that has been developed. It is anticipated that the new functionality will contribute to the advance of the GCI and the broader GEOSS.

The major deliverable items of an AIP phase are:

1. Deployment and registration of components and services that continue to build GCI and the broader GEOSS,
2. Documentation of the results of the AIP Phase in Engineering Reports regarding the scenarios and technical topics, and
3. Demonstration of the newly developed functionality using the SBA Scenarios and selected technical topics.

ORGANIZATIONAL ROLES

The following roles are performed by organizations contributing to an AIP:

Participants

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

IP Team

The AIP 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 AIP Task Leader leads the IP Team. The IP Team includes software architects who have been committed by their organizations to provide a high degree of technical leadership in the AIP.

GEO Secretariat

The GEO Secretariat contributes to the AIP process by reviewing consistency of proposals and their progress with the GEO Work Plan, and with activities of relevant GEO (sub)task Teams, GEO Implementation Boards and GEO Task Forces. The Secretariat serves as routine interface to these parties, and requests participations of IP Team members or participants whenever needed. This role is particularly relevant for crosscutting issues such as implementation of data sharing principles and the quality assurance strategy. The GEO Secretariat logistically supports AIP teleconferences and meetings.

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 AIP IP Team 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.

SYSTEM DESIGN PROCESS

AIP uses a system design process to implement SBA Scenarios into the GEOSS AIP Architecture based upon engineering Use Cases. This process is reusable for deploying SBA scenarios in a Service-oriented Architecture (SoA). Development of architecture models is a step towards a mature GEOSS: "Creating explicit models of a system's design is the step leading from art to practice."[2] AIP begins with the standard architecture practice of describing a system from multiple viewpoints [3].

The core of the reusable process is: community Scenarios and transverse Use Cases. Scenarios are narrative description of the activities of the SBA communities with minimal discussion of the implementation architecture. Scenarios provide an end user view of the value of GEOSS. Scenarios are implemented in the GEOSS architecture by use cases. Use cases describe reusable functionality of the GEOSS service oriented architecture implemented through Interoperability Arrangements. This process builds on these core concepts using a system modeling process based on international standards tailored to the GEOSS environment. The reusable process for deploying SBA Scenarios into the GEOSS AIP Architecture is shown in Figure 2 and described in Table 1. This process is iterative with the main flow of activities as shown in the Figure, but the process is not accomplished in one pass.

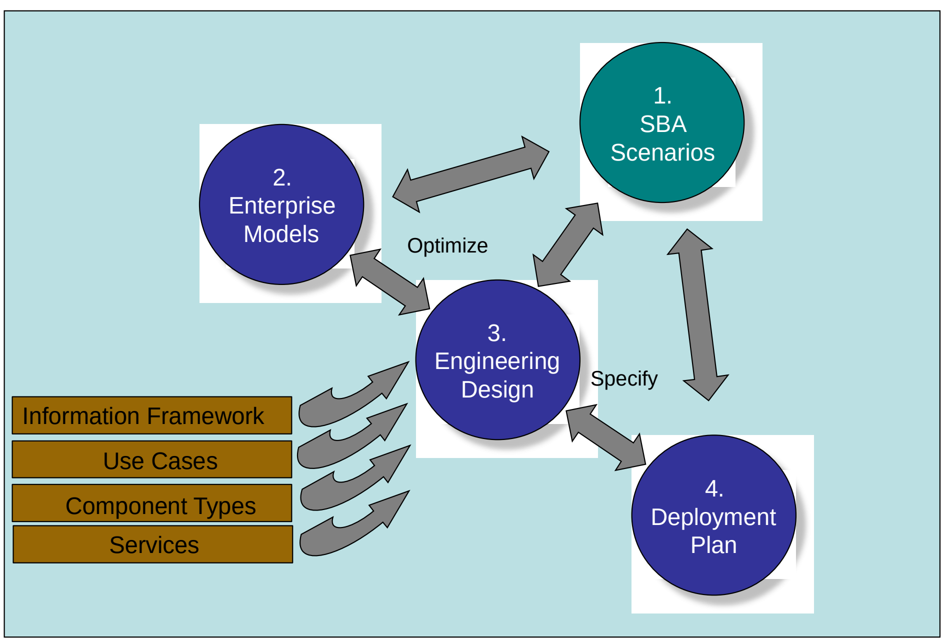

Figure 2 – Design Process to Deploy SBA Scenarios

Table 1 – SBA Scenario Deployment Process Steps

Step	Activities	Artifacts
1. Scenarios	SBA community experts develop narrative descriptions of *processes* for the desired behavior of decision makers using Earth Observations in the context of GEOSS Scenario development occurs with a general understanding of GEOSS. The SBA community experts develop the narrative with an understanding of the basic GEOSS architecture, e.g. the *generalized use cases*.	• Objectives • *Scenarios* • *Processes*
2. Enterprise Models	AIP system engineers - working with SBA community experts - elaborate and specify the scenarios into enterprise models. Steps in the *processes* are detailed in *activity* actions.	• *Activity diagram* • *Enterprise objects* • Context diagram
3. Engineering Design	AIP architects - working with the SBA Community experts and AIP system engineers - develop optimized designs for the enterprise models by applying and refining SoA *use cases*, *information objects,* and *component types*. Each *activity* action is assigned to a pre-existing *generalized use case* or a *specialized use case* is developed. Interoperability arrangements are chosen and registered with the Standards and Interoperability Registry as necessary with support from the SIF.	• Refinement of *Generalized use cases* • *Specialized use cases* • *Information objects* • *Component Types* • *Interoperability Arrangements*
4. Deployment	Component providers – working with AIP architects and Community Moderators – identify, develop (as necessary) and register a set of *component instances* based upon the engineering design into the Components and Services Registry. Components include those provided by the community and discovered in the wider GEOSS. Deployment includes testing that the components meet the community objectives. Demonstrations are developed to communicate the system operation to users. Best practices are identified. With SIF assistance, if necessary, the component provider and community should enter best practice drafts into the Beat Practices Wiki for further editing and formalization.	• *Component Instances* • *Persistent Exemplars* • *Demonstrations* • Components and Services Registry • Best Practices Wiki • SIF

AIP-6 GEOSS WATER SERVICES

One of the most recent pilot projects, GEOSS Water Services, demonstrated how to capture and publish water resource information, for use at all levels of society including policy makers, engineers, researchers, and the general public. In the last decade, development work in water information exchange standards has resulted in adoption of the Open Geospatial Consortium (OGC) WaterML, which is now being considered for adoption within the World Meteorological

Organization (WMO). WaterML can be used for a wide range of observation types, including stream flow, precipitation, flood level, water quality and other variables. The WMO Global Runoff Data Centre (GRDC) and Global Precipitation Climatology Centre (GPCC), as well as many national agencies such as the U.S. Geological Survey (USGS) and National Climate Data Center (NCDC), maintain collections of such water resource information, mostly accessible through web sites.

REFERENCES

[1] GEO Work Plan 2012-2015: http://www.earthobservations.org/geoss_imp.php
[2] Cf., “Notes on the Synthesis of Form,” Christopher Alexander, Harvard Press, 1964, and “Systems Architecting,” Eberhardt Rechtin, Prentice Hall, 1991.
[3] International standards for architecture all require a set of views: IEEE 1220, ISO/IEC 10746, ISO/IEC 19793 .