

Discovery and Delivery of Space Geodetic Data Products from Distributed Archives

Annual Report

**Submitted by Frances Boler, PI
UNAVCO, Inc.
6350 Nautilus Dr.
Boulder, CO 80305**

Performance Period: January 29, 2010 through November 29, 2010

NASA Grant Number NNX10AF07A

Submitted to

**Stephen Berrick, NASA Headquarters, Technical Officer
Martha Maiden, NASA Headquarters, Technical Officer
NASA/NSSC, Grants Officer**

Project Accomplishments

The GSAC-WS project to modernize the mechanisms for exchange of metadata for space geodetic products is making excellent progress towards achieving the project goals and completing project schedule deliverables. The teams from UNAVCO, CDDIS, SOPAC, and the University of Nevada, Reno have been assembled, have met in a face-to-face meeting at UNAVCO in Boulder, and participate in monthly teleconferences. A public website for the project has been created at UNAVCO (<http://facility.unavco.org/data/gsacws>) and a collaborative team project wiki and mail forum system has been created on Google Sites/Groups to facilitate project management and interactions. The teams have worked to define metadata elements to be exchanged, overall software system architecture, metrics requirements, and the role of metadata standards in the project. To encourage community awareness and participation, the project was presented at the summer IGS meeting, three project related abstracts have been submitted to the fall AGU meeting, and an invitation to participate in a community advisory group has gone out to selected individuals. Software development has progressed slightly ahead of schedule. Software release in alpha to project partners of two key pieces of the GSAC-WS software system, the GSAC Service Layer and the GSAC Repository took place in the second quarter. In the third quarter, SOPAC implemented the repository software. Working test versions of a queryable repository with web interface exists at UNAVCO and SOPAC in alpha release. The queries access UNAVCO's and SOPAC's production databases. Implementation of the software for the CDDIS repository is underway and an alpha version of the federated search repository has been fielded. The UNR team has progressed with analysis capabilities that will allow station QA to be assigned.

Project Activities

The major engineering accomplishment at UNAVCO for the GSAC project has been the development of the GSAC Service Layer (GSL) and the development and first release of the GSACWS UNAVCO Repository by Jeff McWhirter. The major components of the GSL are shown in Figure 1 below. The UNAVCO Repository can be accessed at:

<http://facility.unavco.org/gsacws/gsacpi/site/form>

The UNAVCO GSACWS Repository provides a web query interface and serves as a test bed for the development and refinement of the GSACWS Web Service API. It provides the ability to do a variety of GNSS site queries (e.g., spatial, temporal, equipment, etc) as well as queries on UNAVCO's data holdings. Along with the HTML interface various other representations of the results are provided (see below) including Google Earth KML, Javascript Object Notation (JSON) and CSV.

The GSL is a generic Java Servlet layer that provides a set of common services for repositories. The GSL sits on top of a GSAC Repository implementation (e.g., UNAVCO's). The GSL handles all of the incoming web service requests with the GSAC Servlet component. This component orchestrates the various system components and routes the request to the underlying repository. The repository instance processes the query (e.g., using its underlying database) and returns the results to the GSL in the form of GSAC Data Model objects. The Output Handlers within the GSL are responsible for encoding the result data model into the requested format. For example, the GSL currently supports HTML, JSON, CSV, KML, RSS, ATOM and other text encodings.

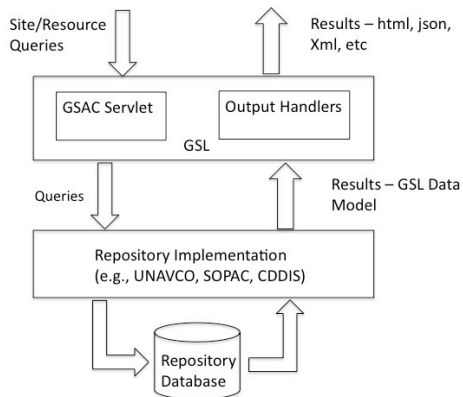


Figure 1: GSAC Service Layer Architecture

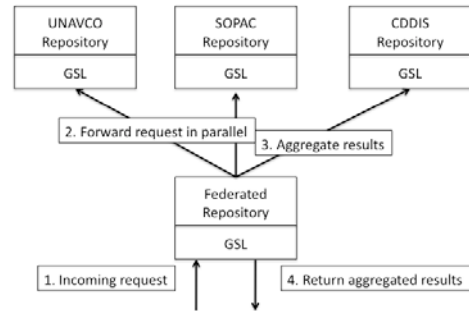


Figure 2. Federated repository

The GSL is based around a Model-View-Control paradigm. The GSAC Servlet is the controller, the underlying repository is responsible for constructing the model and the Output Handlers create the views of the content. This decoupling of model from view is critical in that it enables the rapid development of new encodings and result formats. For example, we envision making use of the GeodeticML format, developed at SOPAC, as a future encoding. We will also investigate various other metadata standards (e.g., ISO 19115, DIF, FGDC) as possible encodings.

As part of the GSL effort we have also developed a GSAC Repository template package and code generation capabilities. This allows a repository developer to rapidly generate the Java code that provides a basic implementation of a repository, vastly reducing the overall development effort. This package generation process also includes the generation of the build and release scripts. We have made use of this template mechanism in all three implementations of the GSACWS repositories (UNAVCO's, SOPAC's and the CDDIS repository).

Carey Noll, CDDIS project CO-I, provided a subset of their current metadata (yearly data type-specific catalogs and site information) to UNAVCO for a strawman implementation of a search capability of the CDDIS database using the set of alpha tools developed for GSAC search. The CDDIS archive consists of not only GNSS data/products but additional data types (laser ranging, VLBI, and DORIS). Differences in the nomenclature for site information will need to be addressed in order to provide an interface for the CDDIS consistent with the UNAVCO and SOPAC GNSS-only archives.

During the review period SOPAC staff received the first releases of the GSAC alpha software. This software was reviewed and implemented at SOPAC by Paul Jamason with assistance from Jeff McWhirter at UNAVCO. Paul Jamason has been developing the SOPAC repository component of GSAC. This is comprised of SQL-based code for retrieval of continuous and campaign GPS/GNSS site information from the SOPAC database. Software has been written within the repository framework provided where possible, with modifications as needed.

Currently, SOPAC repository development is focused on querying sites based on nominal and spatial requests. Once this stage is complete, development of resource URL and metadata

queries will begin. Paul is also working with Jeff on GSAC nomenclature and vocabulary issues, including a review of existing resources in this area, for example XML schemas for site metadata (“IGS site logs”), GPS campaigns (“PGM”), and time series (“GeodeticML”).

A prototype federated search repository has also been developed and can be accessed at:

<http://facility.unavco.org/gsacfederated/gsacapi/site/form>

As shown in Figure 2, the federated repository also sits under the GSL layer but it handles incoming requests by forwarding them to one or more external repositories. These repositories perform the query and return the results in the GSAC Object xml encoding format. These results are aggregated and delivered to the original requestor.

The team at the University of Nevada Reno (Geoff Blewitt and Corne Kreemer CO-Is) has received documentation and software to use within their processing system for gathering the required data via the GSAC –WS system. The UNR team continues to download and utilize for processing thousands of daily station files. They have provided input to the design for the GSAC system so that they can filter out data which do not meet the requirements of the processing stage.

ESDSWG Participation

The lead UNAVCO GSAC developer, Jeff McWhirter, has been the project's representative to the Earth Science Data System Working Group (ESDSWG). Jeff has primarily been involved with the Technology Infusion Working Group (TIWG), participating in teleconferences and attending the 2010 annual meeting. As part of this effort we have been incorporating and testing out some of the core ideas that the TIWG has been involved in including federated distributed search, Open Search protocols and Service Casting. We have preliminary versions of both a distributed search implementation that spans our three core repository implementations and an Atom-based Service Cast output format. The experience gained in our effort to implement these technologies across our diverse repository holdings has provided us with valuable insight into these areas. In the coming months we intend to document and share with the working group our experiences.

Project Schedule

Overall, the project milestones and deliverables are on track or ahead of schedule with a minor exception noted below. The technical development is ahead of schedule for the web services and interfaces to be developed by UNAVCO and SOPAC. Software implementation by CDDIS is slightly delayed compared to UNAVCO and SOPAC, but still on schedule.

One deliverable, identifying and getting input on GSAC-WS plans via a voluntary advisory panel, is behind schedule. The project is seeking direct community input through engagement of an advisory panel. At the UNAVCO Science Workshop and the IGS Infrastructure meeting many members of the US and international geodesy community were introduced to the GSAC-WS modernization plans; several expressed interest in keeping apprised of the project. Following the informal interactions with the community, a targeted letter inviting panel participation was sent to five individuals. Several of these declined due to overcommitted schedules. Additional community members to target still need to be determined by the project partners.