ArcGIS Framework Plug-In: Extending the ArcGIS Desktop for ANSI Standard Framework Data to Support Government Decision Making

Final Project Report

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Project Narrative

The Framework data is the fundamental data layers of the National Spatial Data Infrastructure (NSDI). It is being cataloged by using Open Geospatial Consortium (OGC)'s Catalog Service for Web (CS-W) protocol and served through OGC Web Feature Service (WFS) protocols.

With the funding support from NSDI Cooperative Agreement Program (CAP) and in collaboration with Environmental System Research Institute (ESRI), the GMU CSISS has developed a powerful ArcGIS Framework Plug-In. It enables a large number of ArcGIS Desktop users to directly discover and easily access the Framework data. By supporting not only the Framework data themes served by WFS-based NSDI servers but also other geospatial data served by Web Coverage Service (WCS) and Web Map Service (WMS) servers, the Plug-In greatly facilitate the access to the Framework data by a broad range of users, including those in agricultural efficiency, disaster management, water management, and homeland security.

The ArcGIS Framework Plug-In has successfully integrated the OGC-compliant data discovery and access services into the ArcGIS Desktop. With the ArcGIS Framework Plug-In, the ArcGIS Desktop supports dynamic data discovery through OGC CS-W, interactive access, overlay, and display of image data as raster layers served through OGC WCS and WMS protocols and feature data encoded in Geography Markup Language (GML) 2.0 and 3.1.1 as standard ArcMap feature layers served through WFS 1.1 protocol, and storage of the Framework data retrieved from distributed sources into local geo-databases for future uses.

A website (http://csiss.gmu.edu/products/arcgisext.html) has been established for the plug-in (figure 1). The website provides:

- General introduction and key features of the plug-in
- Documents about software installation and usage.
- Video about software functionalities and manipulation
- The plug-in software download

More than 20 copies of the plug-in software have been sent out for public testing prior to the final release. Based on the users' feedbacks, all known bugs have been fixed. The final release of the plug-in software is available at the website for users to freely download.

Strengths, Weaknesses, and Future Challenges

The project has successfully developed and delivered the plug-in software with all proposed functions on time. The plug-in is extremely useful for ArcGIS desktop users to access a large amount of data served by not only NSDI data servers but also other OGC-compliant servers worldwide. The main strength of the plug-in is its capabilities to

support all OGC data services, ranging from query and discovery of data or services through the OGC CS-W protocol to access to both vector and raster data through OGC WCS, WFS and WMS protocols. The other strength of this software is its capability to read the complicated GML 3.1.1 as well as compressed GML and save GML data into personal and large commercial geo-databases.

Because different developers have different understandings on the ebRIM profile of OGC CS-W specification, each OGC CS-W server implementation might have its own approach to data and service discovery. For example, to discover the available OGC WFS services, the CS-W of Geospatial One Stop (http://www.geodata.gov/aimscsw/csw2.0) uses "Filter" as the constraint, while the CS-W of GeoBrain (http://geobrain.laits.gmu.edu:8099/LAITSCSF2/discovery) uses "Service/Slot/Name/serviceType" as the constraint. Thus, the plug-in has to be tailored to meet the specific implementations of each OGC CS-W server. At the end of this project, the ArcGIS Framework Plug-In had been worked well with the above two OGC CS-W servers. But we can not guarantee that the ArcGIS Framework Plug-In can work well with other untested OGC CS-W servers.
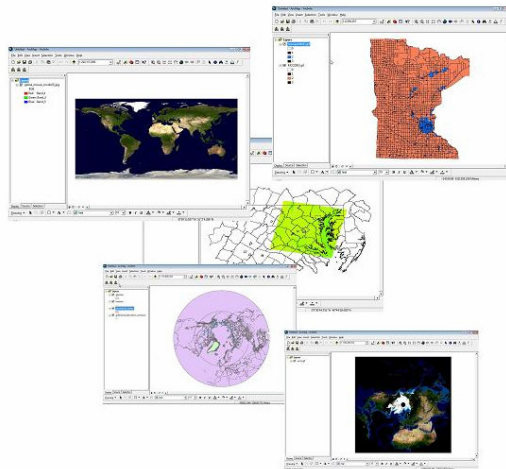

Figure 1. Screen Capture of ArcGIS Framework Plug-in Website

The future challenge for us is to further broad the user base of the ArcGIS Framework Plug-In. We will collaborate with ESRI to make the ArcGIS Framework Plug-In as a standard extension of ArcGIS and publish it at ESRI's website.

Status of your data access activities

The ArcGIS Framework Plug-In is designed to allow ArcGIS Desktop users to not only manipulate all possible Framework data containing millions of features and gigabytes of information, which includes geodetic control, orthoimagery, elevation and bathymetry, hydrography, cadastral, governmental units, and transportation, but also integrate satellite images and their derived products, such as land cover, through OGC WCS and WMS protocols. Currently more than 150 types of Framework data in the following WFS servers are accessed and rendered by the ArcGIS Framework Plug-In.

> http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi
> http://nsidc.org/cgi-bin/atlas_north
> http://nsidc.org/cgi-bin/atlas_south
> http://geodata.epa.gov/wfsconnector/com.esri.wfs.Esrimap
> http://giswebservices.massgis.state.ma.us/geoserver/wfs
> http://nbii-nin.ciesin.columbia.edu/mapserver/wfs/fgdcgubsblockgroup
> http://nbii-nin.ciesin.columbia.edu/mapserver/wfs/fgdcgubscensustract
> http://nbii-nin.ciesin.columbia.edu/mapserver/wfs/fgdcgubscounty
> http://nbii-nin.ciesin.columbia.edu/mapserver/wfs/fgdcgubsstate
> http://nbii-nin.ciesin.columbia.edu/mapserver/wfs/fgdcora

Some descriptions of the selected Framework data from USGS (http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi) are presented in the following table:

Name	Number of Features	Spatial Extent	File Size
Governmental Unit (County or Equivalent)	841	-179.14221197, 18.9108417, -66.94983061, 71.35256069	40.1MB
Governmental Unit (Minor Civil Divisions)	1086	-179.14221197, 18.9108417, -66.94982987, 71.38990002	41.1MB
Governmental Unit (State or Territory)	49	-179.14221197, 18.9108417, -66.94983061, 71.35256069	36.8MB
Hydro Element (Areas - Hi Res)	5278	-173.784439, 17.67302957, -64.54957828, 71.49960662	46.5MB
Hydro Element (Areas - Med Res)	4006	-160.99724839, 18.4977261, -66.88508041, 49.37656952	44.1MB
Hydro Element (Flow Lines - Hi Res)	37112	-173.1163182, 17.67373571, -64.56519181, 71.39038002	109MB

Status of Framework Client Development

The software development phase of project has been completed. Currently the ArcGIS Framework Plug-In supports the following protocols and features:

- OGC CS-W ebRIM profile – discovering data and service
- OGC WCS 1.0 – manipulating WCS raster data as a standard ArcMap raster layer.
- OGC WMS 1.1 -- manipulating WMS image map as a standard ArcMap raster layer.
- OGC WFS 1.1 -- manipulating WFS GML 2 and 3.1.1 feature data as a standard ArcMap feature layer.
- Geodatabase – saving WCS and WFS data into geodatabases, including personal database, file and SDE.

During the software development, GMU CSISS staffs performed continuously the evaluation of the software by testing against GMU CSISS server and a variety of different Framework servers. The pre-public release version of the software were released to USDA FSA, ESRI, and other interested parties to perform evaluation and testing.

The executable of the plug-in is freely available at http://csiss.gmu.edu/products/arcgisext.html. To further inform the geospatial community about the availability of the plug-in, we plan to present the software at AGU 2008 Winter conference and through a set of news briefings.

Project management

The project has been executed smoothly since the beginning of the project. Financial spending is also on target. Although the project has been concluded successfully, we plan to continuously maintain the website to make the software freely available. We plan to maintain the software and fix any bugs reported by users.

Feedback on Cooperative Agreements Program

What are the program strengths and weaknesses?

The program's strength is that it encourages using the cutting edge of computer technologies to fulfill NSDI's objective for making geospatial data interoperable and easily accessible to user communities. The CAP program will have a great impact on developing and promoting NSDI.

Where does the program make a difference?

Without the tools created by the CAP program, the NSDI are very remote to a lot of GIS users. With the tools developed by funding support of the CAP program, NSDI becomes a real and useful resource to those users.

Was the assistance you received sufficient or effective?

Yes.

What would you recommend doing differently?

The program currently provides funding support for one year. One year may be long enough for the software development. But it always takes efforts to maintain, promote, distribute, and support the software. Is it possible for the program to provide additional funding in the second year at the reduced scale for maintenance, promotion, and user support activities, giving the potentially wide use of the software by the broad user community?

Are there program management concerns that need to be addressed? Time frame?

No.

If you were to do this again, what would you do differently?

Because of the one-year time and funding constrain of the project, some things, which we would like to do thoroughly, have not been done thoroughly. If time and funding was allowed, we would like to collect more user requirements from our collaborating organizations for guiding our development and to do more testing against available Framework data services during the development of the software.