Supporting FGDC Framework Data Layer Publishing Using MapServer

FGDC 2004 Category 5 CAP Grant
Final Project Report

December 8th, 2006

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NSDI Cooperative Agreements Program 2004
Implementing Web Services for Framework Data
Final Project Report

Agreement Number: 04HQAG0165

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Project Narrative

Minnesota Department of Natural Resources (DNR) was awarded a Federal Geographic Data Commission (FGDC) Cooperative Agreements Program (CAP) grant in the summer of 2004 to pursue outcomes that would further FGDC's efforts in promoting interoperability and consolidated geospatial data discovery and delivery. Specifically, the project had two principal objectives: 1) establish an operational Web Feature Service (WFS) serving at least one FGDC standards-compliant Framework Data Layer, and 2) prepare a document that would facilitate the use of the MapServer Internet mapping software for serving Framework Data Layers. Both of these objectives have been essentially met, although some outstanding issues remain.

Within the context of this project, WFS services are used to handle data requests from some sort of WFS-compliant software client; returning a document that either describes the capabilities of the server, provides the results of a spatial query, or constitutes a vector data file available for rendering. All returned documents conform to one of the existing Geographic Markup Language (GML) specifications. In short, the elements of the relationship consist of a WFS client, a WFS server, and a data source.

The primary unanswered question at the start of the project was the extent to which the MapServer software could be relied upon to format a GML document in conformance with FGDC specifications, and failing that, what sort of data source manipulations would be necessary to achieve the desired result. Ultimately, the project served to advance MapServer's flexibility in creating conformant documents, while highlighting data processing strategies that would facilitate positive outcomes.

The project never sought to test the viability of large data transfers using the GML format or to evaluate MapServer's scalability in large volume data serving.

Minnesota DNR Web Feature Services

Minnesota DNR is hosting a prototype Web Feature Service in connection with the DNR Data Deli; a multi-faceted geospatial data access site that hosts WFS, Web Mapping Services (WMS), and file-based data downloads. The WFS server component provides access to two data layers for which the Minnesota DNR is the authoritative source (Minnesota State Parks and Minnesota Scientific and Natural Areas). These are served in compliance with a recent draft format Government Unit Boundaries (GUBs) specification. Data are available in conformance with both GML 2.1.2, and GML 3.1, simple features profile.

To the best of our knowledge, there is no final GUB's specification that would serve as the basis for creating an authoritative data server source for the two layers offered by DNR. We are prepared to pursue conformance with the final specification when it becomes available. We also have not engaged FGDC staff in a process to validate our

services for conformance with final standards, although we are also prepared to do so outside of the current grant.

The DNR WFS service appears to stand on uneven ground in the sense that not all WFS clients are able to render output from the site. CadCorp Map Browser has proven to be the most reliable client we have tested, although the application will fail with errors if operated in its most conservative mode. Gaia client software appears to be able to read the GML 2 document result, although it does not seem capable of rendering MapServer-generated GML 3.1 data. Environmental System Research Institute, Inc. (ESRI) software (e.g. ArcMap) does not currently aspire to the role of GML 3.1 client and therefore is not helpful in assessing that particular result. Anecdotally, at least one DNR business partner has been able to use ESRI ArcMap software to view the data using that company's "Interoperability Extension" add-on product.

In summary, the Minnesota DNR WFS site continues to operate as a prototype at the conclusion of the project. DNR plans to continue operating the service with an eye towards hosting fully compliant framework data layer services when the entire enterprise environment matures fully.

MapServer WFS Support

The most important result of Minnesota DNR's CAP Grant participation has arguably been the enabling of MapServer software for framework data layer publishing. Prior to the project, MapServer included a rudimentary WFS capability through which source data could be exposed. With the advent of FGDC framework data layer specifications, it became apparent that the base capabilities present in the software were not sufficient to achieve compliancy with these emerging standards. Minnesota DNR has been in a unique position (through on-going professional relationships) to affect enhancements to MapServer in response to FGDC requirements.

A number of capabilities have been developed in response to FGDC requirements, including: 1) GML 3 document authoring, 2) explicit geometry typing, 3) inclusion/exclusion of attribute elements, 4) attribute aliasing, 5) attribute grouping (concatenation), and 6) a provision for extended attribute support. These functions place MapServer on firm ground for supporting FGDC data standards while reducing data pre-processing requirements for developers wishing to expose WFS capabilities.

Although the enhancements to MapServer are important, comprehensive documentation guiding developers in the use of the software for publishing Framework Data Layers is equally essential. Toward that end, the project took on the creation of a detailed manual for capitalizing on both existing and new functionality available to MapServer-WFS developers. This documentation exists as an on-line resource on a DNR web server (http://maps.dnr.state.mn.us/mapserver_docs/wfs_tutorial). Eventually, the documentation will be fully integrated into the MapServer project website.

Data Management Activity Status

Two geospatial data sets are being served by Minnesota DNR in conformance with draft Government Unit Boundary specifications. As noted previously, these include Minnesota State Parks and Minnesota Scientific and Natural Areas. DNR has statutory responsibility for this information and is therefore in a good position to provide the authoritative source. Both of these data sets are fairly lightweight with source data file sizes of 5.1 Mb and 0.2 Mb, respectively. Each data set is complete for the entire state of Minnesota. Minnesota DNR has stewardship responsibility for all of the data.

The server site resides on a HP 580 server under SUSE Linux 9.2, with MapServer 4.10 and Apache 1.0.49. WFS services conform to version 1.0.0, the latest currently supported by MapServer. Data sources are in ESRI Shapefile format. Output formats are GML 2, and GML 3.1, simple features profile.

Status of Framework Web Feature Service

The DNR State Parks layer has been registered with geodata.gov although it is marked as "disapproved." We are open to working with FGDC to bring the layer into production in conformance with FGDC standards. As an organization with many external business partners, DNR is motivated to engage in initiatives that promote interoperability. That being said, it is clear that Web Feature Services are not currently a viable option for integration with core business functions. Client support for WFS and GML continues to lag well behind the advance of server-side software to author these documents.

Project Management

This project will continue into the future. The level of effort required to maintain this capability is relatively light, and we have an interest in promoting the technology. From here on out, we will be watching for completed standards that we can use as targeted document specifications, although our data offerings will typically be limited to those elements that we are actually responsible for maintaining.

Feedback on Cooperative Agreement Program

The Cooperative Agreement Program (CAP) is a good concept, although the 2004 Category 5 portion included some challenges. First and foremost it appears that the program would benefit from additional staff support, particularly in the area of data standards development. In our experience, data standards advanced slowly, which in turn

reduced vendor incentive to get behind the standards, and ultimately reduced the prospects for feature-based data interoperability. Open Geospatial Consortium (OGC) GML simple features profile release schedules also served to dampen the program and reduce its prospects for success. It is possible that 2004 Category 5 was simply too far out in front of the standards development work upon which it relied, although optimism on the part of the program designers was not unwarranted. Many of us expected GML to be much more pervasive than it turned out to be at the time this report was prepared. Instead, it has gravitated toward specialized vertical applications, and away from generalized interoperability. As an organization, OGC seems to respond best to specific market interests, while standards such as the Simple Features profile, which could have a much more broad impact on organizations seeking to exchange general data types, was not completed and promoted within a time frame that would have benefited the project.

We appreciate the flexibility that FGDC has extended to DNR in the execution of the grant, with regards to workplan modifications and schedule adjustments. Our experience with FGDC technical and administrative staff has been uniformly positive, with high levels of professional expertise apparent throughout the grant period.