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Ionic Enterprise Software, Christopher Tucker & Eddie Pickle, (the company is no longer in operation)

Project History

In 2004, the NC Geodetic Survey (NCGS) embarked upon the unexpectedly lengthy migration of its legacy, file-based data repository of geodetic monument information to a modern, relational database system. The NC Geodetic Survey is part of the NC Department of Environment and Natural Resources's (NC DENR) Land Resources Division. NCGS's primary mission is to apply state-of-the-art methods of precise positioning and advanced geodetic techniques to establish and maintain the official survey base of the state of North Carolina and to support mapping, boundary determination, property delineation, infrastructure development, resource evaluation surveys and scientific applications. NC DENR's Information Technology Services Division designed and maintains a J2EE/Oracle based internet-enabled enterprise application and database system, called IBEAM, for internal departmental data management and reporting, and has not been spatially enabled until the conclusion of this project. In 2005, as the requirements and design phase for the new Geodetic database system was nearing completion, DENR business and IT staff determined that the new database system for surveying control monuments should be augmented with a map interface.

The available funding levels at the time precluded the development of a completely integrated full GIS into the IBEAM module, but the goal was to provide basic spatially enabled data, and allow users to visualize it on a map and download copies of it. With the announcement of the 2005 CAP program's available funding in Category 2: Establishing Framework Data Service Projects, the NC Geodetic Survey and NC DENR ITS identified this as a potential opportunity to achieve the goal of spatially enabling the Geodetic Monuments database; Geodetic Control Monuments being one of the seven "Framework" National Spatial Data Infrastructure (NSDI) data layers. It was also determined that the data would be served to NC OneMap, a fledgling GIS portal for NC that, at the time, was hoped to become North Carolina's version of Geospatial OneStop. By serving framework data to NC OneMap, the NC Geodetic Survey would become a participant in the NSDI. The additional requirement of this project category; partnership with a software vendor who would provide software capable of serving OGC Web Feature Services and training and integration experience during the project implementation phase was also identified as a positive factor in the decision to apply for funding.

After researching the array of potential vendor partners, a short list of companies whose software was known to be OGC compliant and capable of serving spatial data using the emerging Web

Feature Service specification were identified. Of the potential candidates, Ionic Enterprise expressed great interest in partnering on a proposal with NCGS and NC DENR. Their product, RedSpiderWeb, was java-based and deemed a good candidate for integration with NC DENR's java/Oracle-based IBEAM system. A grant proposal was submitted to FGDC, and was ultimately selected for an award in the 2005 CAP program.

As part of this project, Ionic Enterprise received half of the grant award to cover their development staff time and the cost of the software. NC DENR IT and NC Geodetic Survey staff agreed to supply the 50% CAP cost match in the form of in-kind services in staff time to spatially enable the database, integrate the map interface for IBEAM, and develop the Framework Web Feature Service for Geodetic Control Monuments. The majority of the java programming for the IBEAM module has been accomplished through contracted programming services. Half of NC DENR's portion of the CAP award was allocated to purchase a new map server and the other half used to extend the availability of the contract IBEAM developer to assist with the integration.

In February, 2006, a representative from Ionic Enterprise spent one week on-site at NC DENR, assessing the state of the Oracle database in relation to the then draft FGDC Geodetic Control schema, and instructing DENR GIS staff in the operation of the RedSpider Web software. During that week, the current (at the time) instance of ESRI's SDE spatial database middleware (v 9.0) was installed into the development instance of the IBEAM database and the initial attempts to spatially enable the control monuments commenced. DENR IT's database administration team had reservations about installing the SDE software into the database, but at the time, this was considered the only viable option - Oracle Spatial being well beyond the project's budget. After assessing the design of the IBEAM database for Geodetic Monuments, it was determined that several data elements in the draft FGDC Geodetic Control schema had not been addressed for the internal IBEAM application: Local and Network Horizontal and Vertical Accuracy being the primary items. Subsequently, the Geodetic database schema was altered to accommodate the items in the Framework schema, but it was known at that time that values for all of these items would not become available from the National Geodetic Survey until after they completed the National Spatial Reference System readjustment of the nation's control monuments. This was expected to happen in early 2007. IBEAM development work progressed throughout the first half of 2006, but it was determined that until the database was loaded and partially functional, that the enablement of WFS services would need to be delayed. The primary focus was on developing the functionality of the IBEAM module, as the web interface would be the sole mechanism for NC Geodetic staff to manage, edit and update their database. A no-cost extension for the CAP project was requested, and granted by FGDC.

During this time period, some limited testing of ESRI's SDE was accomplished, but the software, at the time, proved to be difficult for DENR's DBA to manage properly due to existing responsibilities and lack of spatial knowledge. DENR IT's policies for access and privileges to edit and interact directly with the IBEAM database were very rigid and limiting, and DENR's GIS Coordinator experienced great difficulty in accomplishing the true role of an SDE Administrator. In late 2006, the project experienced another setback when the National Geodetic Survey's database administrator, who was to supply updated monument information dumps from the national database, died suddenly. The NGS database system had no backup administrator, and the information became unavailable to the DENR project team for several more months, further delaying the project. Mid 2007 saw the project's contract java developer exhaust his contract funding, and the project was moth-balled until the Geodetic Survey could acquire additional funding. Early the next year, the partnering software team from Ionic Enterprise announced that their company was being acquired for their technology and they, as an entity, would be dissolved. Another no-cost grant extension was requested, while the project team re-assessed their options.

Eventually, in fall 2008, an additional source of funding was acquired, and the lengthy State Government procurement process to establish a new development contract was begun. A contractor was selected and hired and the project was underway again, however it was not to be for long. In early December, the contractor abruptly resigned and moved back to India and the project was on hold again.

In the two year period since this project had become stalled, it was determined that that improvements to the Oracle Locator product should be adequate to accomplish spatially enabling the database, and the initial plan to use ESRI's SDE middleware was abandoned, due to few available resources to support it. In late spring of 2009, NCGS was finally able to hire another contract programmer to complete the project, with the completion date set at December 30, 2009. However, the last no-cost extension for the CAP project was set to expire September 30, 2009. After spending an initial time period learning the system and code base, the new programming contractor began making good progress in completing the functionality of the IBEAM module. By early to mid summer, it was expected that the data quality and the integrity of the database would be sufficient for the GIS Coordinator to begin working with the IBEAM programmer and the database administrator to accomplish mapping the internal IBEAM database schema to the FGDC Geodetic Control Monuments schema. The Federal Framework schema had been modified over time, and the final version of the standard was just different enough that it that the geodetic control monuments database design could not fully meet the new schema, and it was far to late to make more changes. The NC Geodetic Monuments database would not be able to fully represent all of the horizontal accuracies for all stations in a local network, because it was designed to meet an earlier draft standard that provided for only single values. It was determined that the worst accuracy in a local network would be used, to avoid mis-representing any accuracy information to the surveying community.

In the latest setback on this seemingly ill-fated project, the GIS Coordinator experienced a complex medical issue over the course of the summer and was unable to devote much time to the WFS portion of the project until treatment was completed, in mid September. With such a short time line available, it was determined that scope would be drastically reduced and that the basic spatial enablement of the data via Oracle Locator and publishing a modified WFS that did not fully implement the complex schema with 3 dimensional point objects would be attempted. The Ionic software was no longer functional and it was determined that Geoserver's new complex application schema support would provide the likeliest chance of achieving a level one schema. Some success in spatially enabling the data with Oracle Locator was achieved, but the long history of institutional hurdles related to enterprise database and network access policies contributed substantially to this CAP project's only marginally successful completion on September 30th, 2009. In the end, a copy of the Geodetic Monuments database had to be replicated to a PostgreSQL/PostGIS spatial database resident on the mapserver so that data access could be accomplished before the project deadline.

Current status of data management activities

A number of data quality issues were identified as contributing to the inability of either the Geoserver or Mapserver software to successfully publish a level one schema, but a level zero, simple features WFS of Geodetic Control Monuments is operational, as is a WMS service and simple map viewer. The identified data quality issues will be resolved before the December 30th completion date for the IBEAM module portion of the project, and another attempt to map to the level one schema will be attempted using Geoserver.

The NC Geodetic Survey's Geodetic Control Monuments database is maintained jointly between the NC Geodetic Survey and NC DENR's ITS Division. It currently contains over 38,000 geodetic control monuments, covering the entire extent of North Carolina. Roughly 5300 of these monuments are the highest quality monuments that were included in the 2007 National Spatial Reference System adjustment project. The focus in the later stages of this project has been solely on this subset of the database, as they were considered much more important. A great many of the other monuments are only simple benchmarks or other lower accuracy stations.

The original Dell PowerEdge 2950 server that DENR's GIS Coordinator purchased for the project is still in use and serving well as a map and data server. It is currently running both Minnesota Mapserver and Geoserver software, as well as the new installation of PostgreSQL/PostGIS database. It is anticipated with the long awaited access to spatial database technology, that the additional grant proposal objectives of serving other, much larger DENR datasets as WFS services will be possible. In past attempts, using file based data formats, the performance proved to be inadequate. Some duplicate data records were discovered very recently. This proved to be one of the largest sources of errors and frustration in getting either Mapserver or Geoserver to recognize the data from the spatial database as valid. The RDBMS does not care if duplicate features with the same, supposedly unique ID exist, but this condition is not tolerated at all by the map server software, and this condition came very close to preventing a WFS service of any kind being published in before the CAP project deadline. An important lesson learned here is that data quality should be addressed early and often, as it is the foundation of all of the applications built upon it.

The WFS service for the Geodetic Control Monuments will be registered with Geodata.gov as soon as the Geodetic Survey completes a metadata review and update, as Geodata.gov requires current metadata. DENR expects that to be completed very soon. The WFS service has not been publicly announced yet, that is pending the Geodetic Survey's review of the data for quality control purposes. NCGS anticipates that the number of control monuments being published in this WFS service to increase rather dramatically once the data quality issues are resolved. The NC surveying community anxiously awaits the completion of the new online geodetic monument IBEAM module, and a mapping component will be well-received.

This project suffered due to an uncommonly high number of technical and loss of personnel issues, as well as extended periods of no activity. Internal agency dynamics also proved an impediment to early success. Implementers of other projects of this nature will be well-advised to have guaranteed database team and project management team support before embarking upon such an effort. Additional mentoring and training from a partnering software integrator/vendor would have been very helpful to this project, as GML 3x is complex and not yet well-understood or commonly implemented in most State and Local government agencies.

Feedback on the FGDC Cooperative Agreements Program

The FGDC CAP program has proven over the years to be a good vehicle for State and Local Agencies to partner with software developers and spatial system integrators to explore new technology that would not normally be available. While not all projects are fully successful, even the unsuccessful ones are helpful in identifying where pushing the technology envelope in government is not yet feasible for wide deployment. This agency has participated in several other CAP projects with other vendors that were very successful. Our work with the Carbon Project to develop GAIA is a good example of how much positive impact a research and development test-bed can bring to the geospatial community. A greater level of project support from internal resource earlier on would have increased the success of this project, but a considerable effort by

the database and IT staff was applied in the last weeks of the project. Support from FGDC staff has always been excellent. When NC DENR undertakes projects of this nature in the future, more emphasis will be placed on securing adequate resources and management support internally, as well as project management planning. This would be the single most important thing that we would do differently to help ensure a more successful outcome. Continued participation in NSDI CAP activities, as a contributing partner rather than a primary grant recipient is desirable, as it exposes the Agency to new technologies and improvements in spatial data management that would not normally be available to State Agencies for some time to come.

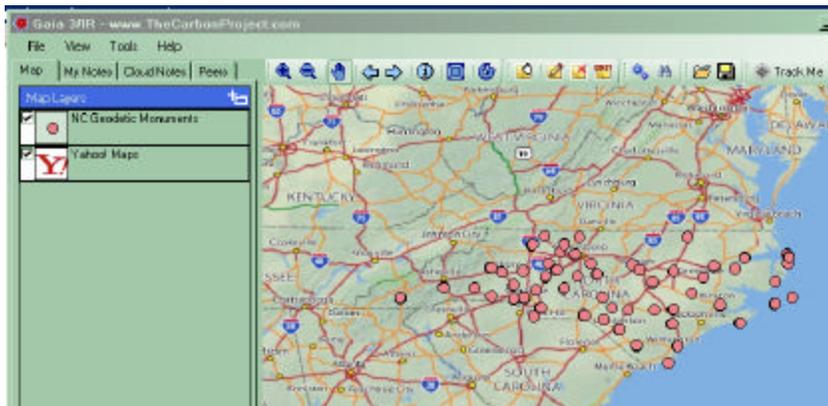
The current url for the WFS service is:

http://wfs.enr.state.nc.us/cgi-bin/mapserv.exe?map=geodetic_wfs.map&Service=WFS&

and the url for the associated (initial) iteration of a map viewer is:

http://wfs.enr.state.nc.us/fist/fistMain.php?site=geodetic_monuments

These are currently powered by PostGIS and Minnesota Mapserver, but Geoserver will be used once the duplicated data quality issues are resolved. Mapserver had much less difficulty in accessing the invalid data than Geoserver experienced. It should be noted that neither package offers adequate error messages, and that debugging connection issues is difficult and time consuming. This project found that using open source GIS desktop clients, such as QGIS, and GAIA to offer better error message support. They were invaluable in the debugging of the map services at the close of the project, when time was a critical factor. The feature service has been tested and functions with GAIA, a free OGC client developed by the Carbon Project, in partnership with NC DENR on a different CAP grant. It is not compliant yet with the Federal Framework schema, but it does provide desirable information about the geodetic control monuments that has not previously been available in a web service.



Other open WFS clients that have been able to interact with the WFS include OpenJump and uDIG. ESRI's ArcMap, however, has limited true support for WFS services, without purchasing extra cost extensions. We find that there is still widely varying abilities in commonly available WFS client software and that vendor implementations are still, unfortunately, not compatible across the board with each other. WFS as a data delivery service specification is complex, and still not widely adopted yet in State and Local Government Agencies. As geospatial software has continued to evolve over the last several years, it seems that the simpler, "mass-market" approach of GeoRSS, JSON and REST web services to deliver data have been gaining traction much faster than WFS. Perhaps this approach will be easier for resource-scarce State and Local Government Agencies to implement, particularly with the ever increasing array of good quality Open Source GIS software projects available today, that were not available at the beginning of this project.