

A Demonstration of the Digital Atlas of Montana

Duane Anderson

ABSTRACT

The Montana Natural Resource Information System, a program of the Montana State Library, has developed and deployed a state of the art 'Digital Atlas' of Montana available via the Internet. Using this application, users can find a place of interest to them, and view a dynamically created and maintained atlas of information about that place. The atlas includes a broad range of data categories such as land ownership and use, census data, and a broad range of water related information (water rights, fisheries, water quality, etc.). The system was designed with ArcSDE, ArcIMS, and MapObjects.

INTRODUCTION

The Montana Natural Resource Information System (NRIS), a program of the Montana State Library, was established in 1985 by the Montana Legislature. It was designed to simplify the task of identifying and acquiring natural resource information for Montana and making this information readily available to potential users.

In 1987, NRIS began the development of a comprehensive GIS program, funded largely by the ARCO Superfund activities on the Clark Fork River. In fact, NRIS was the first Montana State program to develop and foster GIS capabilities and was an early user of Environmental Systems Research Institute's (ESRI) ArcInfo program (customer number 186). The GIS program evolved into a statewide clearinghouse, assembling and delivering standardized GIS data (in ESRI format) through the late 1980's and early 1990's. In August of 1994, NRIS went live on the World Wide Web, hosting its first public Internet page and moving GIS data delivery functions to that medium. In April of 1995, NRIS, via an FGDC grant, launched its first implementation of an FGDC Clearinghouse node with about 200 metadata records. We currently host nearly 400 metadata records and coverages for Montana via the FGDC Clearinghouse node. Current data holdings are available directly from NRIS via <http://nris.state.mt.us/gis/gis.html>. We also recently signed an MOU with Montana's Department of Administration officially recognizing NRIS as the data access portal for the National Spatial Data Infrastructure (NSDI) framework data in Montana (<http://nris.state.mt.us/nsdi>).

As technology advanced, we began the exploration and development of interactive web applications in hopes of expanding the user base of our large data holdings from only GIS professionals using GIS software to a much broader user community of non GIS users (citizens, planners, regulators, recreationists, etc) who had legitimate, yet largely unavailable, needs for the powerful analytic and mapping capabilities that GIS technology offers. In September of 1997 NRIS deployed its first ESRI MapObjects Internet application (Montana Maps) that

provided users the ability to browse, view, and query several major data layers for the State of Montana. This was followed by the launch of the Montana TopoFinder in January 2000. TopoFinder allows users to browse, search, and print USGS Topographic maps for the entire state (over 3,000 quads) plus toggle between the topographic maps and the USGS's 1m aerial photographs. This system turned out to be hugely popular and currently serves over 5,000 requests per month.

The next phase of Internet development focused on a more powerful tool, with much broader application and capabilities. The *NRIS Thematic Mapper* was the result. First deployed in the fall of 2000 and subsequently modified and improved over the past several years, the application supports a broad spectrum of spatial queries, provides a variety of access outputs for the data in the area of interest (reports, maps, shapefiles), and provides access to an ever expanding list of data themes to users forming **The Digital Atlas of Montana**.

The resulting application currently provides over sixty custom map views of data, customized to the area of interest provided by the user, spanning the data spectrum from census and base map data through climate, environmental impact, and comprehensive land and water information. The data and outputs are available 24x7 via the Internet, to any and all users interested. New data and map 'profiles' can be readily added as we expand and update our data holdings.

The NRIS Thematic Mapper has been a resounding success, providing non-technical users unprecedented access to the vast GIS data resources available at NRIS. Since its launch in the fall of 2002, the Mapper has serviced nearly 850,000 requests.

METHODS

Data Design

In designing what we knew would be a multi-user, high load application, our first consideration was the form in which we would store and serve the GIS layer data. We opted to use ESRI's Spatial Database Engine (SDE), in concert with Microsoft's SQL Server. Our first installation of SDE was completed in the fall of 1999 using SQL Server version 7 along with SDE version 3 on a Windows NT Professional operating system. Over the course of the past several years we have upgraded all three software systems and are currently running on Windows 2000, SQL Server 2000, and ArcSDE 8.2 (soon to be upgraded to 8.3).

We commenced data loading of initial layers we knew would be required for the early implementations of the application limiting those to vector layers (early versions of SDE did not support raster layers). Currently we have nearly 200 SDE layers or SDE views available through the SDE database. We are extremely pleased with the performance and functionality of this platform and have loaded some very large layers (up to 1 million polygons) with no serious performance problems.

Application Design

The next phase of the project involved the conceptual design for the application and its functional requirements. Some of the most basic functional requirements included accommodating minimal client requirements (application should work over low bandwidth connections, use basic Internet browser, run on slower machines, etc.), providing spatial searches for polygon, line, and point feature types, providing on the fly mapping (with zoom, pan, and identify), dynamic report and shapefile creation, and finally, having a flexible, extendable architecture so that new data themes or map views could be readily added.

Because we wanted a system that was quickly adaptable to any new map view, data theme, or reporting requirement without making application or code changes, we elected to control the *Thematic Mapper* through the use of a relational database system. We coined the term '*map profile*' to describe the database entries for a given map profile that would control all aspects of the data, map and report presentation for a particular data theme (or combination of themes). Map profiles control what layers will display in the view and in what order, what scale dependencies they may have, symbology, rendering options, and legend control, field displays and aliases for the identify feature, URL coding functions to allow for dynamic creation of links using fields in the data layer, whether or not the layer is clipped on the fly, and what reports will display with the map view.

Each map profile is defined in the Profiler table; each profile can have many themes displayed (ProfileTheme table); each layer must have an entry in the Layers table. The Layers table is actually built and maintained by the SDE installation so all layers used by the Thematic Mapper must be loaded into SDE. For each layer they can be many different renderers (Render table) and each renderer can have multiple render symbols (RenderSyms table). Each map profile can display one or more active reports defined in the ProfileReport table and each report is described in the ReportDesc table. Finally, additional layer controls are stored in the LayerLookUp table. An entity relationship diagram of the database is shown in Figure 1.

Once the functional requirements, conceptual design, and database were completed, application programming, testing, and debugging were conducted. The mapping application is written in Visual Basic using ESRI's MapObjects, and the Internet presentation was developed using standard HTML. All reporting is done with Microsoft's Active Server Pages (ASP). The initial prototype application was first deployed in the fall of 2000. It had a very limited map profile set, reporting tools, and user interface.

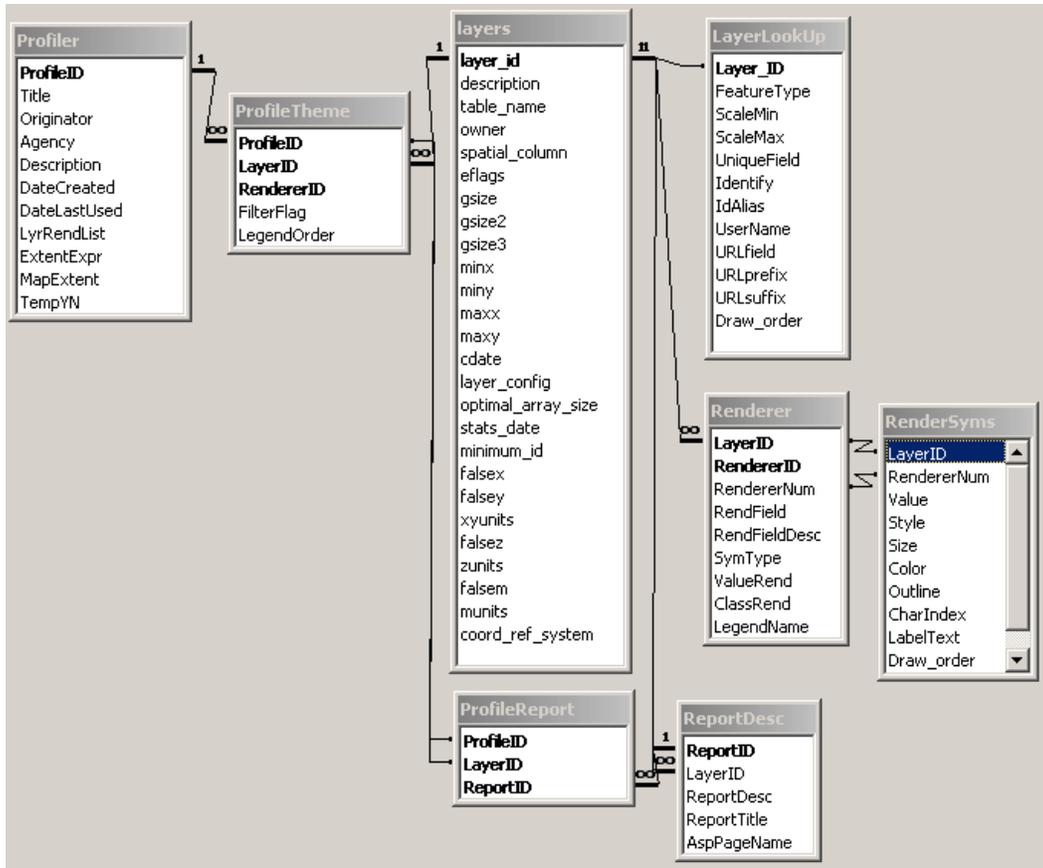


Figure 1. ER Diagram for Thematic Mapper.

In the fall of 2000, NRIS was awarded a grant for the Institute of Museum and Library Service (IMLS) entitled ‘**Development and Demonstration of a State Lead-Library Model for Providing Effective Public Access to Digital Map and Related Spatial Data Through the Internet**’. This grant facilitated continued development and enhancements to the prototype system. Significant application changes and enhancements were made, the user interface was improved, many more data layers were loaded, and many new map profiles were created. In early 2002, we revised the overall data presentation of the Thematic Mapper and began referring to it as **The Digital Atlas of Montana**.

RESULTS / USING THE DIGITAL ATLAS

The NRIS Thematic Mapper’s output of the **Digital Atlas of Montana** can be found at <http://nris.state.mt.us/mapper>. Using the application is a three step process; 1) Select the type of geographic area you wish to query (county, highway, stream, etc.), 2) make a choice within that geographic type, and 3) select and view a particular data category (map profile) from the list of those available.