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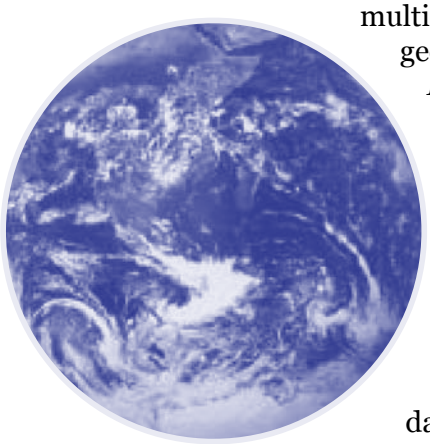
imagiNEWS

IMPROVING MICHIGAN'S ACCESS TO
GEOGRAPHIC INFORMATION NETWORKS

Leveraging the RDBMS within the Geodatabase

By Brooks E. Kelley

Most county and local governments maintain three core datasets: addresses, parcels, and street centerlines; many also maintain building information. Additionally, many county and local governments have been migrating older CAD, coverage, and MapInfo-based spatial datasets to ESRI's *geodatabase* data structure. Many of these communities have built larger, multi-user "enterprise" geodatabases using *RDBMS (Relational Database Management Systems)* such as Oracle or SQL Server.



While moving file-based spatial data into a RDBMS does provide immediate benefits (in terms of centralized data management within a multi-user environment), simply shoving "flat" layers into a database "as is" misses the point and does not maximize the true potential of the technology. Modern RDBMS are sophisticated software, developed and refined over decades, which when used properly can turn an average municipal spatial data store into a highly optimized utility useful to both GIS and non GIS users alike.

Functional enhancements to the ArcGIS Server Basic (nee ArcSDE) product over the past several releases facilitate better integration with the host RDBMS. This means GIS professionals designing enterprise-level geodatabases have greater access to and interaction with underlying database functionality than ever before. This article will explore such functionality within the context of an address database.

RELATIONSHIPS AND NORMALIZATION

Within RDBMS, information about things such as addresses, buildings, and centerlines are stored as *records* within *tables*. Attributes of these records are stored in *fields*. Individual records within different tables are related to one another through common field values or *keys*. The process of efficiently allocating information within one or more tables is known as *Normalization*.

For example, a parcel may have zero or more addresses and zero or more buildings. Likewise, a building may be located on one or more parcels and be associated with zero or more addresses – which may be different than those of associated parcel(s). Finally, a section of a street may be associated with zero or more addresses and, in turn, zero or more parcels and/or buildings. Diagrammatically, these relationships can be depicted as follows:

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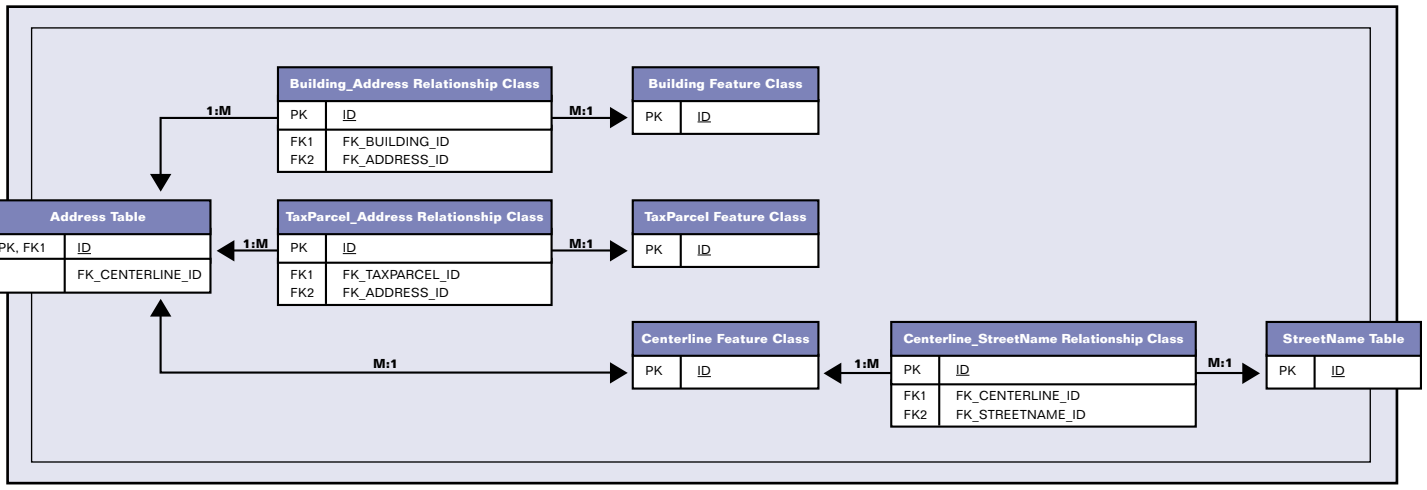
LEVERAGING THE RDBMS *Continued from page 1*



This *ER Diagram* (short for "entity-relationship diagram") presents the address, street name, buildings, centerline, and tax parcel tables as well as the *association* or *intersection* tables that model the many-to-many relationships between them. Note that all tables contain a unique *primary key* and these keys are the basis for all relationships. Also note that certain tables, and all association tables, contain *foreign keys*. These foreign keys allow repeating primary key values. Taken together these primary and foreign keys facilitate one-to-many relationships. For example, one centerline record can be associated with many address records.

VIEWS AND DE-NORMALIZATION

De-normalization is, as the name implies, the opposite of normalization i.e. the process of re-introducing redundancy. De-normalization at the data level is often done for the sake of performance. De-normalization at the presentation level is always done for human interpretation. Within RDBMS such as Oracle or SQL Server, de-normalization can be accomplished through SQL-based *queries* and formalized within *views*.

Structured Query Language, more commonly know as *SQL,* is the language of the modern RDBMS. Think of it as the means by which to "talk" to the database. Except instead of an actual stimulating conversation, your interaction will be in terms of rather ridged, well-structured queries. For example, the following query would present all fields within the addresses table as well those related records in the centerline table:

```
SELECT *
FROM ADDRESS A,CENTERLINE C,
WHERE A.FK_CENTERLINE_ID = C.ID
```

This is useful as one can now determine which individual addresses are associated with each street segment. SQL-based queries can range in complexity from simple ones such as this to much, much more sophisticated ones.

Views are queries stored within the database. They look like ordinary tables. They simplify user interaction by encapsulating (and hiding) complexity. A view based on the previous query, for example, would provide users a single, de-normalized, table-like source for all address information. Put another way, a user would not have to know the underlying mechanics of how these tables are related but only that there's a single, easy-to-use source of address information.

GEODATABASE

OK, so one can efficiently model complex relationships within a database and present these to users using query-like views but RDBMS have been around since the 1970s and they've always done that. "So, what's the big deal?" you may

ask. The big deal is that GIS has finally come of age in terms of RDBMS. Since the acquisition and release of its SDE product in 1995, ESRI has made steady progress harnessing the power and flexibility of RDBMS. This includes development of the enterprise-level geodatabase (including domains, subtypes, topologies, etc.), replication, version-based editing (and more recently base table reconciliation within the versioned environment), as well as support for "open" OGC (Open Geospatial Consortium, Inc.) simple feature and ISO (International Organization for Standardization) spatial data types. Those last two items – base table reconciliation and support for "open" data types – are important. GIS professionals can continue managing and maintaining spatial data using ArcGIS while other, non GIS professionals not familiar with these tools can work with spatial data in a familiar environment.

MAINTENANCE

Maintaining a normalized geodatabase, such as this sample one, is surprisingly easy provided you understand the design **and** the interaction of the geodatabase and underlying database. This is especially true when it comes to versioned-based editing.

Many people have implemented core RDBMS objects such as views and triggers only to discover that they did not worked as planned. More often than not, this could be traced back to versioning. Keep in mind, the default version within a versioned geodatabase, is still a version and should not be confused with the underlying base tables. The base tables are only updated when data is compressed from the delta tables. For many implementations this may only occur when the geodatabase is unregistered as versioned.

To overcome this limitation, the option to move edits to base was added at version 9.2. This option allows edits to be reconciled and posted not only to the default version but also the base tables. While this option does impose certain limitations (in terms of topologies, archiving AKA "history", and geodatabase replication), it guarantees better synchronicity between the default version and base tables. This means users of both ArcGIS and other client applications "see" the same thing. It also provides better support for layer views as these are based on the base tables, not a version.

USABILITY

Back to the example. Suppose there were a view, or more specifically a layer view, that joined the building, address, centerline, and street name tables. Building geography would come from the building feature class, address and unit number (apartment, suite, etc.) from the address table, and street name information from the street name table. Due to the relationships, buildings with multiple addresses would appear as stacked polygons even though there's no such duplication in the building feature class. This means editors would maintain highly normalized tables – one building, ten addresses for example – while casual users would interact with a more flexible, de-normalized view e.g. point-and-click on a building and get ten addresses! And furthermore this would work with heterogeneous client applications.

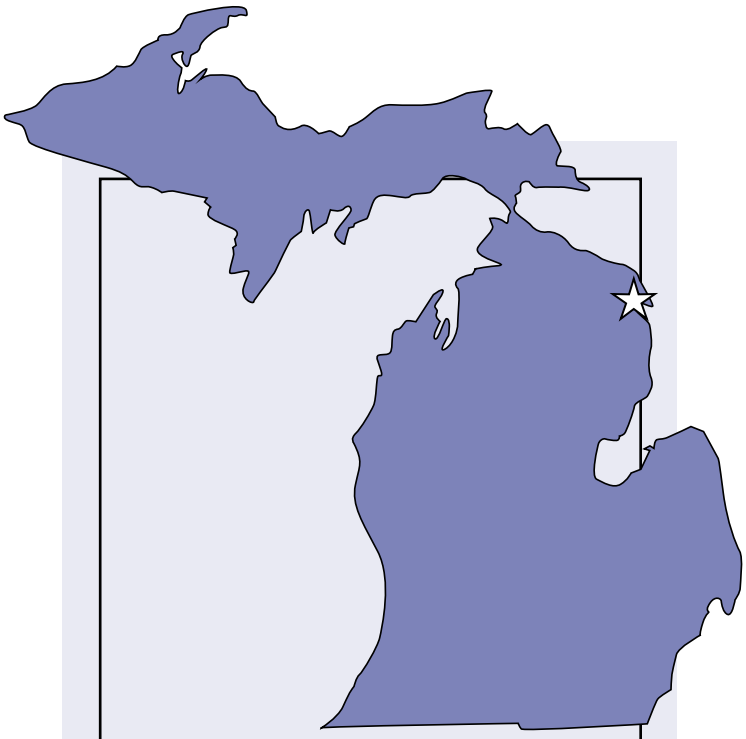
Now, this is a rather simple example, developed for a short article. But it does demonstrate several things. First, RDBMS provide an environment in which to model data efficiently. Second, the geodatabase brings this environment into the GIS realm. Third, recent functional enhancement to enterprise geodatabase software allow for greater interaction between the two technologies. This, in turn, creates many new opportunities for modeling and using spatial data. And this is what makes GIS data modeling fun.

For more information, contact InfoGeographics Senior Consultant Brooks E. Kelley at (231) 995-8266 or bkelley@infogeographics.com

Member News

Muskegon County Property Information Analyst Thomas Van Bruggen recently met the standards and requirements as established by the GIS Certification Institute to become a certified GIS Professional (GISP).

Alpena County



Program Summary

Population: 32,000

Geographic Coverage:
640 square miles (1657.592 km^2)

Number of GIS Staff:
5 (Equalization Department)

Annual Budget: $252,680

Program Status

For many years, Alpena County has experienced a significant need for a computerized mapping system. There have been many attempts in the past to get things up and running but there were always obstacles, usually involving funding or personnel. In 1995, the previous Equalization Director, with the help of NEMCOG (Northeast Michigan Council of Governments), began to create property layers using C-MAP. A good deal of progress was made in a time span of five years, however, it came to a halt in 2000 when personnel changes occurred in the Equalization Department. Between 2000 and 2006 there were small attempts by other departments to produce GIS layers using ArcView but those attempts were never targeted at producing a parcel base layer and eventually failed.

By early 2006, the County Board of Commissioners understood the importance of a county-wide computerized mapping system and the benefits it would bring to 911, Equalization, and many other departments. With the support of the County Board and a healthy budget, the Equalization Department took over the County's digital mapping. The Department's first step was to bring in a representative from NEMCOG to train staff to convert the old C-MAP line files into polygon shapefiles using ArcView. Upon completion, about 50 percent of the County had been properly converted with no attributes. Using old hand drawn parcel maps, the current assessment roll, and any layers found online, staff started in what was determined to be the easiest township and made their way section by section. Staff mapped what was needed; making any splits and combinations that took place in the past six years and also fixed any legal descriptions that showed discrepancies.

Up-to-date orthophotography was acquired in the spring of 2006 and from that point on the process was relatively straightforward. The development of the parcel layers became expedited and the photos that were produced led to a heightened interest in this project. In February of 2007, the Department was finished with its parcel layer and had a parcel number attached to all 22,000 parcels. Using ArcView, assessing data from the Pontem Software database was joined to the parcel layer. This provides a powerful, map-based interface to this rich database. Users now have access to nearly every property-related attribute one could ever need.

New Programs and Activities

Equalization staff now spend what little time they have set aside for GIS developing layers for 911 dispatchers, emergency responders, disaster

readiness, voting districts and precincts, and consistently keeping the parcel and road layers up-to-date. They develop anything from flood maps to proposed trail systems to voting districts and precincts to fire department boundaries and much more. An upcoming project in the planning process is the correction of thousands of addresses around the County that will eventually lead to the purchase of suitable 911 software. This software will work hand-in-hand with the GIS database. Looking back, it's hard to believe that just a couple years ago the Equalization Department had nothing but a stack of torn up books full of hand drawn maps. People would take one look and decide to seek another source for data.

Today, the County receives nothing but praise for the quality of its maps and many of the local units of government have taken great interest in them for a variety of needs. Alpena County is a small county with minimal funds and minimal personnel. No one in the Equalization office has taken a single GIS course and as busy as the office is, this isn't a realistic expectation anytime soon. Nevertheless, the Office made it work with what it had and it was well worth it.

Staff now believes it's time to take it to the next level. The goal in the future is to convince the County Board of Commissioners that the County needs a GIS Department that has a full-time employee concentrating on nothing more than county mapping and addressing.

Lessons Learned/Recommendations

One lesson learned is that the County should have never operated as long as it did without a GIS mapping system. The County was intimidated by it and inaccurately assumed it would take a high level of training and education to even get started. It turns out that it took only eight hours of training and a genuine, dedicated interest.

A large problem experienced once up-and-running was that the parcel layers were saved as shapefiles instead of feature classes in a geodatabase. The shapefiles were very unstable when they got to a certain size and much information was lost! No problems like that have occurred since building a geodatabase.

Another lesson learned is to make accuracy a higher priority. The Department has significantly raised its standards in the last year and what was reasonable a year ago is not now. Existing problems are cleaned up as they surface. Usually when someone is purchasing a map or staff are splitting a parcel is when one notices these accuracy issues. These problems usually involve an offset between parcel lines and the roads as well as what's seen in the aerial photography. At that time staff will make those changes in that area or maybe revise the entire section. This has been very effective, since staff do not have the time to go through every section. It's nice to do a little bit at a time.

Don't be hesitant on taking that step towards a GIS Mapping System. Do not be intimidated. Contact your regional council of governments and ask them to walk you through the process of getting started. You need to also educate your board on the benefits that GIS will bring to the whole community. Their support will prove invaluable. Stay in contact with all your neighboring jurisdictions that have already made this transition because you will be able to learn from them.

There are many layers out there for the taking and you will have a beautiful base to start with before you even start drawing your parcels. Once you see all this come together you will be hooked. The more you map, the more confident you get and before long people will start to realize the asset that they have.

Alpena County Senior Appraiser Harry Guthrie can be reached at (989) 354-9566 or guthrieh@alpenacounty.org

THE CALL IS OUT!

Don't miss this professional opportunity to submit your entries and nominations for IMAGIN Awards and Map Gallery

IMAGIN AWARDS

Every year, several individuals are recognized for their contributions to Michigan's geospatial profession at the IMAGIN Conference. Nominations are requested for the following awards to be presented at the 2009 Conference:

- The Jim Living Geospatial Achievement Award is presented to an IMAGIN member in recognition of exceptional career-long dedication and commitment in the field of GIS/Geospatial Sciences.
- The GIS for Everyone Award is given to an organization that does an outstanding job of making GIS data or analysis available to either organizations or to the public.
- The GIS in Government Innovation Award is presented to an organization that finds innovative ways using geospatial solutions to solve problems. This is a new award and more information can be found on the IMAGIN Awards website.

Recipients will be recognized at the 2009 IMAGIN Conference awards banquet.

Criteria and submittal information is located on the IMAGIN website (www.imagin.org/awards). All nominations must be submitted to the IMAGIN office by March 31, 2009.

IMAGIN MAP GALLERY

Also, don't forget to submit your Map Gallery applications in for this year's conference. Two new categories have been added – the ***People's Choice Award*** and the ***Best Interactive Online Map*** in addition to the ***Best Cartographic Design*** and ***Best Analytical Integration.*** The deadline for submissions is April 17, 2009.

IMAGIN announces Zsolt Nagy and Vicki Lukas as Keynote Speakers for Annual Conference

Don't miss this year's IMAGIN Conference, The Geospatial Journey: Finding Our Way Together, with special guests, Zsolt Nagy and Vicki Lukas.

Zsolt Nagy is Manager of the Coordination Program at the North Carolina Center for Geographic Information & Analysis and staff to the North Carolina Geographic Information Coordinating Council. He provides executive support and consultation to the Council, and oversight of NC OneMap, an intergovernmental initiative to organize statewide enterprise geospatial data assets. Zsolt is currently a member of the National Geospatial Advisory Committee and former President of the National States Geographic Information Council.

Vicki Lukas has over 18 years of experience as a geographer with the USGS. Last October, she was selected as the Partnership and External Coordination Chief for the National Geospatial Program. In June, 2008, she was appointed as project leader for the Federal Geographic Data Committee's "Imagery for the Nation" project to develop a reliable, sustainable imagery program in partnership with state and local governments. Ms. Lukas was recently recognized nationally with the NSGIC Outstanding Service Award.

Join your colleagues in Lansing on May 4 and 5 for the Conference by registering at www.imagin.org

IMAGIN Annual Conference

The Geospatial Journey:
Finding Our Way Together

May 4-5, 2009

Causeway Bay Hotel, Lansing
(formerly the Holiday Inn-South)

2843 East Grand River Ave #230
East Lansing MI 48823
www.imagin.org

IMAGIN is a non-profit 501(c)3 organization comprised of individuals and organizations interested in the use and application of geographic information system (GIS) technology in Michigan. Our members are committed to improving the quality and availability of digital data necessary to make good use of GIS. We believe that cooperation and open communication are necessary to achieve these objectives.

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