imagi NEWS

Accelerating ArcSDE

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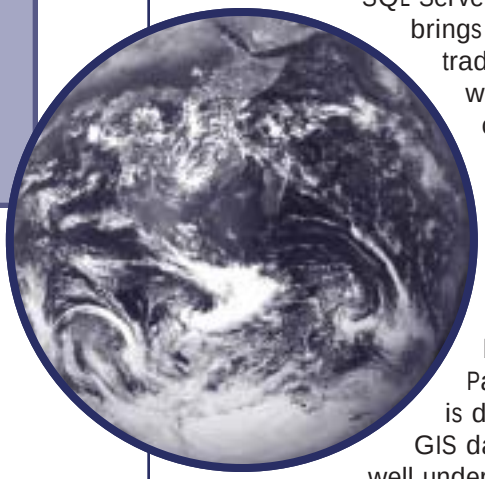
what's inside



ESRI's Spatial Database Engine – now known as ArcSDE – facilitates the storage of geographic information within commercial Relational Database Management Systems (RDBMS) including Oracle, DB2, SQL Server, and Informix. It brings all the advantages traditionally associated with RDBMS, such as centralized data management and processing with distributed access, to the world of GIS. However, implementing ArcSDE can be challenging. Particularly challenging is designing a nimble GIS database that performs well under pressure. Herein are a few (there are many more) well-tested performance tips to help those just starting out with ArcSDE.

Please note these recommendations are written from an Oracle perspective. However, most of these should translate well within other supported RDBMS.

SETTING UP YOUR DATABASE

One's greatest opportunity for performance tuning an ArcSDE database – or any other database for that matter – actually comes before any data is loaded. Taking time to thoroughly setup and configure a RDBMS for ArcSDE will provide performance rewards well into the future.

ArcSDE stores geographic data in layers or "feature classes" to use the new ArcGIS lingo. Within the database, each feature class is composed of three tables. These are referred to as the business or "B" table, feature or "F" table, and spatial index or "S" table. As IO (input-output) is the slowest part of the system, spread B, F, and S tables across at least three tablespaces or data files. Put field indexes in a fourth. The following disk-based architecture is recommended by ESRI for Oracle-based ArcSDE implementations:

Disk 0:	Oracle/Application software
Disk 1:	SYSTEM, Control File 1
Disk 2:	Rollback Segments, TEMP, Control File 2
Disk 3:	REDO 1, 2, 3 Export Files
Disk 4:	Feature Data (F# tables)
Disk 5:	Spatial Index Data (S# tables)
Disk 6:	Attribute Data (Business tables)
Disk 7:	Oracle Indexes (on Business, Spatial, Feature, and other tables)

If your data will be stored on a RAID device, substitute the word "tablespace" for "disk" in this architecture.

Other miscellaneous setup tips include: 1) use read-only tablespaces for static data - reserve read/write tablespaces for data that actually changes, 2) turn logging off in Oracle "create table" statements - leaving it on causes ArcSDE to check if it's on every time a query is made, 3) turn logging off for indexes as well, and 4) avoid logging changes (i.e. using "achieving logs") unless necessary.

ACCELERATING ArcSDE continued on page 3

Who's Doing What in GIS and Spatial Technology?

by ***Jeremy Vermeer***

NAME: Clinton County
POPULATION: 64,700+
SIZE: 576 Square Miles (1491.8 km^2)

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The GIS Department of Clinton County was founded in 1997. In the Spring of 1998, the County acquired 2 foot (60.96 cm) resolution digital orthophotography for the entire County and 6 inch (15.24 cm) resolution orthophotography for the County's more urban areas. A pre-existing base of informational layers had been created and maintained by the Drain Commissioner's Office.

To date, the County has used digital orthophotography to enhance their current layers while creating new data including:

- Parcels
- Addressable Street Centerlines
- Drainage Districts
- 5 foot (152.4 cm) Contours
- Lakes, Streams, and River Data

This past winter, InfoGeographics of Traverse City was contracted to enhance a website housing a portion of the GIS data available through Clinton County. The initial website framework was purchased from Greene County Ohio. Parcel data coupled with information provided by the Equalization Department, and a few other layers, are now accessible via the Internet.

Someone can simply type in a last name, address, or parcel number, in order to access a map of the particular parcel and its surrounding area. A map is generated showing the parcel highlighted in blue. Beneath the map is parcel and owner-specific information. Users may then zoom or pan to their needs, view publicly available parcel data, or add certain additional layers. They also have the option to select all parcels within a predetermined distance of 100, 200, 300, 400, or 500 feet surrounding the parcel. A visual display of the surrounding parcels is shown, along with a listing of the specified addresses. This, and other, attribute data may then be downloaded in dBase file format for mailings or simply for future reference. This option is a very valuable asset for property or utility notifications.

A link is available through the MIS/GIS page on the County's web site: http://www.clinton-county.org.

Another of the County's recent landmark projects pertains to geocode-enabling the County's street centerlines for emergency purposes. Over the past seven months, the County's 911 Central Dispatch has funded an intern to work on addressing this core layer. A fairly accurate centerline file was provided by the County's Drain Office, and a GPS unit used to add new roads. Each line segment, between each road intersection, was then tagged with an address range along with other information used by Central Dispatch. This was an extremely tedious job that demanded tremendous patience and accuracy.

WHO'S DOING WHAT continued on page 4

ACCELERATING ArcSDE continued from page 1

SIZING YOUR DATABASE

There is a science to sizing a database. RDBMS purists will sum up the maximum number of bytes per row of each table and then multiply this value times the number of rows to determine the maximum amount of space required. ArcSDE makes this process a bit more difficult. While there is a one-to-one relationship between the business and F table, the size of the S table will vary depending upon the selected spatial index grid. ArcSDE's numerous indexes only complicate the situation. While the Appendixes A of the various ArcSDE Configuration and Tuning Guides (versions exist for Oracle, SQL Server, and DB2) do have some useful suggestions regarding sizing, if you have the luxury of simply loading the data willy-nilly, do it! Once each layer's data is loaded, check the size of the tables and indexes, then delete the layer and reload it using a keyword.

Keyword: STREET

Parameter: F_STORAGE

Configuration String: "TABLESPACE TSF1 STORAGE (INITIAL 50M NEXT 50M PCTINCREASE 0 MINEXTENTS 1) PCTFREE 1 PCTUSED 99 NOLOGGING"

Figure 1: Components of the street layer's F table storage entry from DBTUNE

Keywords are cool. They tell ArcSDE how to load data i.e. how much space to use for the B, F, and S tables, associated indexes and in which tablespace to put these database objects. Within ArcSDE 8.1, keywords are stored within a table called DBTUNE. This table can be imported and exported. Hint: export this table and edit it using a text editor; never try to update it using SQL.

LOADING YOUR DATA

Now that you've constructed a well-organized database, determined the size of its various elements, and defined keywords to load these elements, it's time to load the data. In general it is best to load layers from the largest to the smallest. This is especially true with SQLServer-based ArcSDE implementations.

Before you start, be certain to coalesce the tablespaces to ensure you have plenty of contiguous space. Coalescence is a tablespace-oriented process roughly analogous to file system defragmentation in that the database attempts to group a large number of blocks into adjacent areas. Also, if you routinely add, drop, or truncate tables, you may want to re-coalesce these tables' tablespaces from time-to-time.

Once all the data layers are loaded, recalculate their envelopes. The layer envelope, or extent, defines the area in which the layer is located in coordinate space i.e. X and Y minimum and maximum values. If the layer envelope is not defined, ArcSDE will have to perform a full table scan each time the layer is accessed to determine this information. From a performance perspective this is not a good thing.

Use "turbo" layers! Turbo layers are layers based upon other layers where individual features have been agglomerated in multipart features based upon a grid. For example, a dense, urban street centerline layer can be quite large as it's composed of many, individually attributed street segments (database rows) corresponding to city blocks. If this layer were "turbo-ized" using a grid size equivalent to the length of 10 city blocks, all street segments within a 10x10 block area would be merged into one feature. Or, from a database perspective the number of rows would be reduced from many to one! The upside of turbo layers is they draw extremely fast because the database deals with fewer rows; the downside is all attribute information is lost.

Turbo layers are most useful in cartography-oriented applications (think web) where the rapid display of map information is desired. Coupling turbo layers with their source layers facilitates quick draw times and "information tool" like point-and-click functionality i.e. use the turbo layers for image rendering and the source layers for attribute query and display.

ArcSDE 8.1 contains a command line routine called "sdegroup" that can be used to create turbo layers.

ACCELERATING ArcSDE continued on page 4

ACCELERATING ArcSDE continued from page 3

MAINTAINING YOUR DATA

As your database is likely to change over time, here are a few tips for maintaining a zippy geographic database: 1) on occasion rebuild indexes on tables where numerous adds/deletes occur, 2) recalculate the layer envelope on these same layers, and 3) if layer tables start to span many extents, export and re-import them using modified keyword values.

TUNING YOUR APPS

Two things to remember when designing GIS applications for use with an ArcSDE database are 1) scale-based display is always good and 2) spatial queries are expensive. The amount of time needed to render a map is directly proportional to the number of feature records fetched from ArcSDE. Therefore, only render dense features, such as parcels, when the user has zoomed to a larger scale i.e. smaller spatial extent. Benchmarking is the best way to determine threshold scales at which to toggle the display of various layers. Also, whenever possible use attribute, rather than spatial, queries. For example, never select parcels within one township by overlaying the parcel and township layers. Instead add a township field to the parcel business table, populate it with name or code values, build an index on it, and then use SQL to select the desired parcel records.

While it is hoped that these tips and tricks, as well as those found within ESRI's documentation and on their website, help you get started with ArcSDE, please keep in mind, tuning a RDBMS is not an easy task. It involves a significant investment of time and energy and may require assistance. Emphasis should be placed on understanding how users of the database will interact with it e.g. what information needs to be displayed or what fields are routinely queried. The database should be designed and implemented with these things in mind. Once up-and-running, monitor databases use and benchmark common tasks. Use this information to better the database.

References:

ArcSDE Configuration and Tuning Guide for Oracle Redlands CA: ESRI Press (2001).

Raad, Mansour. "ArcSDE Performance Tips" Nineteenth Annual ESRI User Conference. San Diego Convention Center, San Diego CA. 1999.

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WHO'S DOING WHAT continued from page 2

A combination of AutoCAD Map 2000, ArcView 3.2a, and ArcInfo were used throughout the project.

AutoCad Map was used to update existing, and add new, street centerlines as well as attach the specified object data. ArcView was then used as a quality control device to seek out mislabeled line segments. Finally, 15 district coverage layers, including various fire, rescue, EMS, and law were created using ArcInfo. These layers are used to determine what emergency unit is appropriate for the specific nature of the emergency call in relation to the geocoded address location.

Once active in Central Dispatch's Computer Aided Dispatch (CAD) System, a map will be displayed to each dispatcher along with the caller's information. Responding police officers will also be able to view approximate address locations via a flat screen display within their vehicles. In the near future, dispatchers will have the option of adding not only 2 foot pixel resolution digital orthophotography, but also layers containing the location of fire hydrants, water shutoff valves, etc.

Future projects will continue to lean towards Emergency Services as well as some projects based around the Sheriff's Department. Recently there has been a significant interest in crime trend studies in addition to various traffic studies. Also being considered is another aerial fly-over in the spring of 2004. The building footprints will be coupled with the new aerial photos to further enhance developmental studies as well as provide advanced information to emergency services.

The GIS Coordinator of Clinton County feels very fortunate to have worked with a County that enthusiastically supports the GIS program. The high-resolution digital orthophotography has been labeled as the greatest asset. Coupled with the digital orthophotography, the past years of information created by the Drain Office, hard work, and the ability for the staff to learn, have been the key elements behind establishing a sound GIS Department.

IMAGIN Conference 2002: Geography on the Move

GIS AWARDS AND MAP GALLERY COMPETITION

The Quality Committee of IMAGIN is pleased to announce the 2002 GIS Awards and Map Gallery Competition to be held during the IMAGIN Conference, April 29 – May 1, 2002, Grand Traverse Resort and Spa. Take this opportunity to support and recognize GIS professionals throughout the state as well as display your latest map projects for the Michigan GIS community to enjoy. Awards will be given on Tuesday, April 30th during the Conference. GIS Award and Map Gallery applications are available at www.imagin.org along with specific submittal instructions.

Submission deadline for the GIS Awards and Map Gallery Competition is April 4, 2002.

GIS Award Categories

1. GIS Education and Outreach Award
2. GIS for Everyone Award
3. Outstanding Individual Achievement in GIS Award

Map Gallery Competition Categories

1. Best Cartographic Design
2. Best Analytical Presentation
3. Best Data Integration
4. Best Cooperative Presentation

From the Events Committee . . .

We have been hard at work going through all the abstracts we've received! A record number of abstracts were submitted and thankfully we were able to find presentation time slots for nearly all of them! There promises to be a wide variety of great GIS talks for local government, natural resources, web technology, and more! Six workshops have been scheduled prior to the Conference beginning for specialized interests.

Two exciting speakers have been scheduled for Tuesday's lunch and dinner! During lunch on Tuesday be sure to catch the presentation given by Bob LaMacchia, an assistant division chief for geocartographic service from the U.S. Census Bureau. He will discuss the 2000 Census and how it relates to Michigan. Then, after dinner on Tuesday, the author of *The Island of Lost Maps*, Miles Harvey, will talk about cartographic theft as it happened historically and present day.

The 2002 Conference promises to be a smashing hit! In addition to all the great talks and guest speakers, on Sunday night we have an Exhibitor Appreciation wine tasting planned at a local winery and on Monday night the Turtle Creek Casino will provide shuttle service and a gaming coupon book to all conference attendees!

Conference mailings and information will be posted on www.imagin.org. Check the website for registration information.

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