Administering Your Microsoft SQL Server Geodatabase

Thomas Dunn and Shannon Shields
Topics for this presentation

• News since last UC
• How do I . . .
  - Configure SQL Server to support geodatabases?
  - Create databases and geodatabases?
  - Choose from among spatial data storage options?
  - Organize my data?
  - Control access to my data?
  - Make sure that my data is safe?
  - Improve performance?

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News

ArcGIS and Microsoft changes since last year
Connections to Geodatabases and Databases

• At 10.1 you can easily access spatial data in a database that is not a geodatabase through a regular connection (not just with Query Layers or the Data Interoperability Extension)

• At 10.1, you can easily create a geodatabase in a new or existing database using GP tools
Support at 10.1 for new Microsoft database releases

• SQL Server 2012
  - Support for SQL Server 2008 R2-level database functionality
  - Support for some new features coming later

• Windows Azure SQL Database
  - Support for databases
  - … but not geodatabases

• ArcGIS direct connections now support mirrored databases
Deprecations at ArcGIS 10.1

- Multiple Database Model geodatabases
  - Existing geodatabases continue to work
  - Cannot create new MDM-GDBs
  - MDM-GDB will become a single database automatically (in the database named SDE) when the last table is removed from associated user databases

- SQL Server 2005
  - Connections can be made earlier geodatabases via pre-10.1 application server

- Many command line tools are being replaced by Desktop UI and geoprocessing tools
  - SDESETUP is replaced by GP tool
How do I ...?

Common questions when working with SQL Server databases and geodatabases
How do I configure SQL Server to support geodatabases?
How do I configure SQL Server to support geodatabases?

• Install a supported version of SQL Server
• Database Engine is the only required component
• Must use Case-Insensitive (CI) collation
• Can use either Windows or Mixed-mode authentication
• The SQL Server Browser can be enabled but not required
What is the SQL Native Client?

• **Microsoft stand-alone DLL required for connections to SQL Server**
  - Provides support for all data types and commands
  - Must be installed on all client machines that connect to SQL Server

• **Use SQL Native Client software at least as new as the SQL Server database engine**
  - Multiple versions may be installed side-by-side
  - MDAC no longer supported: use SQL Native Client
SQL Native Client Location

ArcGIS Client

Direct Connection (SQL commands)

SNaC

Client Computer

SQL Server

giomgr

Server Computer

App Server Connection (SDE commands)
A note about Compatibility Level

- Upgrade database compatibility level after upgrading SQL Server
  - Sets certain database behaviors
  - When databases are upgraded they retain existing compatibility level

- Using Geography spatial type?
  - Upgrade compatibility to 110 when upgrading to 2012 from 2008 or 2008R2

- Description of compatibility level differences
Points to remember

- SQL Server Database Engine is only required component on the server
- The SQL Native Client is required by applications that send SQL commands to SQL Server, including ArcGIS
- Only Case-Insensitive collations
How do I create databases and geodatabases?
How do I create databases and geodatabases?

- A database is a SQL Server object
  - There can be many per SQL Server instance

- A geodatabase is an ArcGIS construct hosted in a database
  - One allowed in each database

- Options for creating geodatabases
  - Use a GP tool to create a new geodatabase from scratch
  - Use a GP tool to create a new geodatabase in an existing database
Choosing a geodatabase schema

- **DBO**
  - Owned by the DBO built-in user
  - Multiple logins can be DBO, so a headless login is not needed
  - Easier to use Windows authentication for administrator

- **SDE**
  - Owner is the database user named SDE
  - SDE user needs fewer permissions than DBO
  - No geodatabase users need to be DBO
Creating databases and geodatabases

Demo
Points to remember

- Geodatabases are ArcGIS constructs stored in databases
- GP tools provide a simple way to create a geodatabase
  - Enterprise geodatabases are 500MB with a 125MB logfile
- For more control over database storage, first create the database using SQL Server tools, then create the geodatabase
- GP tool creates databases in Full Recovery mode
  - Change to Simple recovery if you don’t want to manage backups
- Don’t rename a database that contains a geodatabase
How do I choose from among spatial data storage options?
How do I choose from among spatial data storage options?

- All perform on par with one another
- SDEBINARY has characteristics similar to Geometry, but is stored and indexed differently
- Geometry and Geography can be accessed using T-SQL
How are Microsoft Spatial Types used with ArcGIS Feature Classes?

SQL Server has few restrictions on how spatial type columns are used.

ArcGIS feature classes use spatial data type columns in specific ways:

- Spatial type column appears in Business & Adds tables
- SQL Server creates and maintains spatial index based on parameters provided by ArcGIS
- All shapes in a column must have same Shape.STSrid
  - Controlled by check constraint created by ArcGIS and enforced with a SQL Server
- All shapes must be same type (point, line, polygon)
How does ArcGIS store non-simple shapes in Geometry or Geography?

Some ArcGIS feature elements like parametric curves and point IDs are stored in a side table.

- Named SDE_GEOMETRY<registration_id>
- Contains rows only for each feature that has one or more of these elements
- Joins to only after it contains rows
What are the rules when using the Geography Spatial Type with ArcGIS?

- Must have SRID defined in SQL Server data dictionary (SQL Server rule)
- Cannot violate hemisphere rule (SQL Server 2008 rule)
- Cannot have Z or M dimensions (ArcGIS rule)
  - For performance reasons, ArcGIS uses Well-Known Binary (WKB) interface for validating shapes (hemisphere rule)
  - SQL Server WKB implementation uses 1999 OCG specification for WKB, which does not support Z or M
T-SQL Access to Geometry and Geography

- Query attributes of individual features (area, length)
- Perform spatial queries based on comparing shapes
- Combine spatial and non-spatial attributes in queries
- Leverage T-SQL spatial functions in definition queries and views
- 20-minute session: Using SQL with your Geodatabase
  - Was held on Tuesday 8:30am.
Points to remember

- Three storage types are available: SDEBINARY, Geometry and Geography

- In Geography, calculations are done using Great Ellipse line interpolation, while the others use Cartesian

- SQL Server manages spatial indexes on Geometry and Geography

- Microsoft spatial data types provide SQL access to spatial data
How do I organize my data?

To understand how to organize your data (and grant access to your data) you must first become familiar with the basics of the SQL Server database structure.
SQL Server Principals

- **Logins = Authentication**
  - Who is logging on?

- **Users = Authorization**
  - What can this person do in the database?

- **Schemas = Containers**
  - What are the logical groups of database objects that should be managed as a whole?
SQL Server Instance

Logins

Users

Databases

Schemas

Tables and Views

Procedures and Functions
User-schema relationship

- ArcGIS requires that the database user name and its default schema name are the same for users that create data
  - Not a SQL Server requirement
- Users that are DBO all create data in the DBO schema
- Data readers & editors need not have a same-named schema
User-schema with Windows groups

- A Windows group can be added as a login
  - Associate the login with a database user
  - Do not create a matching schema

- For logins that will create data, SQL Server automatically creates corresponding user and schema

- Recommendation: Data should be created through explicit Windows or SQL Server login
  - Associate login with data creator user
  - Restrict permission for creating data to those users
  - Use group logins for data readers or data editors
How do I control access to my data?

Access to SQL Server objects are managed with permissions granted to logins, users, server roles and database roles.
Limit Permissions for Most Users

- Admin
- Data Owners
- Data Editors
- Data Readers
Who is DBO?

**Sysadmin** fixed-server role members are **DBO** in every database

Database owner is **DBO** in single database

*Db_owner* role members are **NOT** DBO

Have DBO-like permissions
Permissions needed to read, edit or create data

<table>
<thead>
<tr>
<th>Task</th>
<th>Required permissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creator</td>
<td>CREATE TABLE, CREATE PROCEDURE and CREATE VIEW*</td>
</tr>
<tr>
<td>Editor</td>
<td>SELECT, INSERT, UPDATE and DELETE on objects** plus EXECUTE on stored procedures used to generate sequential values</td>
</tr>
<tr>
<td>Reader</td>
<td>SELECT on tables**</td>
</tr>
</tbody>
</table>

* Needed to create multiversioned views on versioned data

** Including feature, SDEGEOMETRY, versioning and archiving support tables, if present
## Permissions needed to manage users

<table>
<thead>
<tr>
<th>Task</th>
<th>Required permissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create geodatabase user</td>
<td>Membership in sysadmin fixed server role</td>
</tr>
<tr>
<td>Create database role</td>
<td>CREATE ROLE</td>
</tr>
<tr>
<td>Compress geodatabase</td>
<td>SDE-schema: SDE user, DBO user or member of DB_OWNERS database role</td>
</tr>
<tr>
<td></td>
<td>DBO-schema: DBO user or member of DB_OWNERS database role</td>
</tr>
<tr>
<td>Kill geodatabase connections</td>
<td>Membership in the processadmin fixed server role, and granted VIEW DEFINITION database permission</td>
</tr>
<tr>
<td>View all geodatabase users</td>
<td>VIEW DEFINITION database permission</td>
</tr>
</tbody>
</table>
## Permissions needed to manage databases

<table>
<thead>
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<th>Task</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Create enterprise geodatabase</td>
<td>Membership in sysadmin fixed server role</td>
</tr>
<tr>
<td>Upgrade geodatabase</td>
<td>DBO user in database</td>
</tr>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td>Member of DB_OWNERS fixed database role</td>
</tr>
</tbody>
</table>
Password Policies

- SQL Server uses Windows password policy
  - Password expiration rules
  - Complexity rules for strong passwords
  - Can be disabled

- Security policy is set in Windows, or the domain
  - Policies may vary from site to site
Managing permissions

Demo
Points to remember

• Creating a user does not give access to data in the database – it must be granted by the data owner
• ArcGIS tools manage permissions on all parts of a feature class, not just the business table
• Creating a user with the Create User tool will grant permissions sufficient for creating data
How do I make sure that my data is safe?

Backups are the only way to reliably protect your data.
How do I make sure that my data is safe?

• Backups allow you to recover from:
  - Media failures
  - User errors
  - Hardware failures
  - Natural disasters

• Also, backups can be used for:
  - Copying or moving data between servers
  - Setting up database mirroring or AlwaysOn

• Use BACKUP command or Backup task in Management Studio
Points to remember

Backups are the only way to reliably protect your data

1. Decide how much time you can afford to lose when disaster strikes and data must be restored
2. Create a restore plan that will achieve that goal
3. Create a backup plan that supports your restore plan
4. Implement your plan
5. Test your recovery plan regularly by using real backup media to restore to a development system
How can I improve performance?
Common Performance Tuning Objectives

- Improve spatial query performance
- Improve Query Layer or spatial view performance
- Improve overall geodatabase performance
Performance Tuning

Demo

Tune a spatial index
Prototype a query
Maintain a geodatabase
Points to remember

- **Spatial Index pitfalls**
  - Gigantic extent
  - Improper tessellation settings
- **Tune queries beforehand**
  - Prototype, trace, examine execution plan
- **Query Layers and spatial views**
  - Simple is better (and faster)
- **Perform geodatabase maintenance**
  - Compress regularly
  - Update index statistics
  - Revisit workflows
Related Demo Theater Presentations

These Demo Theater presentations start in a few minutes

- Working with Microsoft SQL Server Express Geodatabases
  - Demo Theater, Hall C, Wednesday 7/25 from 12:00 to 12:30

- Using Microsoft SQL Server Profiler to Troubleshoot
  - Demo Theater, Hall C, Wednesday 7/25 from 12:30 to 1:00

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