Introduction to ArcSDE for PostgreSQL

Kasia Tuszynska & James Gough
Agenda

- ArcSDE Technology Overview
- Installation and Configuration
- Connecting to the Geodatabase
- Users and Privileges
- Storage Types and Data Loading
- Geodatabase Maintenance
- Additional Resources
ArcSDE Technology Overview

ArcGIS Server Enterprise

GIS clients

Web Client

Mobile

Desktop

ArcGIS Web Services

ArcSDE Technology

GIS data

Enterprise Geodatabase

RDBMS

PostgreSQL
Oracle
SqlServer
DB2
Informix
ArcSDE Technology Overview
Defining the Geodatabase

• Native data structure for ArcGIS
• Container of spatial & attribute data
  - Collection of geographic datasets
• Provides the ability to:
  - Leverage data relationships
  - Enforce data integrity
  - Multi-user editing
Introducing ArcSDE Technology

- Database independent storage and access to Geodatabase
- Adds geometry and raster data types to RDBMS
  - ST_GEOMETRY
  - ST_RASTER
- Multi-user geodatabase editing
  - Long persistent transaction
- Leverages DBMS functionality
  - Security
  - Backup & recovery
  - Scalability
ArcSDE Technology Technology for PostgreSQL

- ArcGIS Server Enterprise supports PostgreSQL
  - Enterprise geodatabases only
  - Not available for Desktop or Workgroup geodatabases
  - All Geodatabase functionality available
- Accessible with clients 9.3 and up
- PostgreSQL 8.3.8 software included
- Available in ArcGIS Server 10 AMIs in Amazon Cloud
ArcSDE Technology Overview
Introducing PostgreSQL

• Open Source RDBMS
  - Developed by Online Community
    http://www.postgresql.org/about/
  - Distributed with BSD license = Free
  - Started as Ingres at UC Berkeley

• Conforms to SQL 92/99 standards

• Comparable to leading commercial DBMS platforms
  - Supports complex database features
    (UDT, views, table inheritance, stored procedures, extensible index
     framework, etc...)
  - Client library interface available in many languages
    (C, C++, Java, Perl, Python, Lisp, etc...)
## ArcSDE Technology Overview

### What versions are supported?

- **PostgreSQL Version:** 8.3.8, 8.4.1
- **PostGIS Version:** 1.4.0


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<th>ArcSDE 9.3.1</th>
<th>ArcSDE 10</th>
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ArcSDE Technology Overview
EC2 Amazon Cloud Machine Images

• Enterprise Geodatabase Ami, contains:
  - PostgreSQL 8.3.8
    - Sdegdb database
    - Logins: sde, editor, viewer
  - ArcSDE 10.0 SP2
  - License File

• Available from ESRI Customer Service Account
  - EGDB Ami accompanies the AGS Ami
Agenda

• ArcSDE Technology Overview
• Installation and Configuration
  – ArcSDE Installation
  – Upgrade Workflow
• Connecting to the Geodatabase
• Users and Privileges
• Storage Types and Data Loading
• Geodatabase Maintenance
• Additional Resources
Installation and Configuration

Installing on Windows

- ArcSDEPostgreSQL.exe includes:
  1. PostgreSQL 8.3.8 Installation
  2. ArcSDE Installation
  3. Post-Installation for ArcSDE
     - Create Database, sde user and tablespace
     - Create ArcSDE Repository in database
     - Authorize ArcSDE
     - Create ArcSDE service
Installation and Configuration

Installing ArcSDE with PostGIS

- Install PostgreSQL
- Install PostGIS
  - Create new database based on template_postgis or use PostGIS database
- Install ArcSDE
- ArcSDE Post Installation
  - Use PostGIS enabled database
- Grant privileges to all users:
  - grant select, insert, update, delete on public.geometry_columns to ...
  - grant select on public.spatial_ref_sys to ...

Refer to: Technical Article 35128
Installation and Configuration
Installing on Linux

1. Install PostgreSQL \textit{(RPM or source)}
   - create\_pgdb.sde - run as root user \textit{(RHEL only)}

2. Copy 2 spatial type libraries from sdehome/bin to postgres/lib
   - st\_geometry.so, libst\_raster\_pg.so

3. Create database, sde user, sde schema, grant privileges…
   - setup\_pgdb.sde - run as postgres user \textit{(RHEL only)}

4. Install ArcSDE
   - install \texttt{--load}

\begin{itemize}
  \item Technical Article 35488 to install ArcSDE & PostGIS on Linux
  \item Technical Article 37828 to install ArcSDE on SUSE 10
\end{itemize}
Execute ArcSDE Post-installation wizard to create geodatabase
Agenda

- ArcSDE Technology Overview
- Installation and Configuration
- Connecting to the Geodatabase
  - PostgreSQL Connection Configuration
  - Application Server Connection
  - Direct Connect
- Users and Privileges
- Storage Types and Data Loading
- Geodatabase Maintenance
- Additional Resources
Connecting to the Geodatabase

PostgreSQL Connection Configuration

- Modify configuration files to enable connectivity to database cluster:
  - `postgresql.conf`
  - `pg_hba.conf`

- Restart database cluster or reload configuration

- Error will occur if not modified:
  - In ArcGIS: “Bad login user” error
  - In pgAdminIII: “Server not accepting connections” error
Connecting to the Geodatabase

ArcSDE Application Server Connection

- ArcSDE service is running
- Enter **ArcSDE port number or name** in Service field
Connecting to the Geodatabase
ArcSDE Direct Connect

- No ArcSDE service required
- PostgreSQL client drivers included in ArcGIS
- Enter ‘sde:postgresql:<name of server>’ in Service Field
Agenda

- ArcSDE Technology Overview
- Installation and Configuration
- Connecting to the Geodatabase
- Users and Privileges
  - Creating Users
  - PostgreSQL Schemas
  - SDE User and Data Owners
  - Data Editors and Data Viewers
- Storage Types and Data Loading
- Geodatabase Maintenance
- Additional Resources
Users and Privileges

Creating Users

- PostgreSQL has:
  - Roles
    - Login roles: database accounts
    - Group roles: database roles
  - Schemas
    - Data logically stored in a schema

- Types of users:
  - PostgreSQL superusers: postgres, sde
  - Data Owners, Data Editors, Data Viewers
Users and Privileges

Creating Users

- Create schemas for users that own data
  - SDE user – ArcSDE system tables
  - Data owner – user data
- ArcSDE requirement: schema name = user name
- PostgreSQL specific schema privilege: USAGE
  - Allow execution of functions in schema
  - Allow non-data owners to access data
  - Grant usage to login role, public role, or group role

ERROR 999999: Error executing function. Underlying DBMS error [Grantee editors does not have USAGE permission on schema loader.
] Failed to execute (ChangePrivileges).
Users and Privileges

SDE User and Data Owners

- **SDE user**
  - Created automatically

- **Data Owner**
  - Created by DBA
  - schema name = username
  - Important privileges:

```sql
create role owner login password 'owner' CREATEDB;
create schema owner authorization owner;
grant ALL ON SCHEMA owner TO owner;
grant USAGE on schema owner to public;
```

See SQL script example in:

`sdehome/tools/postgres > roles_schema_privileges.sql`
Users and Privileges

Data Editors and Data Viewers

• Grant data privileges in ArcGIS or ArcSDE as Data Owner
  - Data Editors: select, update, insert, delete
  - Data Viewers: select

• Can be in a group role as an option
  - Each user has a login role and added to a group role
  - Grant inherit privileges at login role

create role map login password map inherit;
create role editors;
grant editors to map;

Refer to: Technical Article 36684
Creating Users
Granting Privileges
Agenda

- ArcSDE Technology Overview
- Installation and Configuration
- Connecting to the Geodatabase
- Users and Privileges
- Storage Types and Data Loading
  - Storage Types
  - Loading Data
  - DBTUNE
- Geodatabase Maintenance
- Additional Resources
Storage Types and Data Loading

User Defined Spatial Storage Types

- ST_Geometry
  - Developed by ESRI

- ST_RASTER
  - Developed by ESRI

- Geometry
  - Developed by Refractions Research
Storage Types and Data Loading

User Defined Spatial Storage Types

ST_GEOMETRY

- OGC Compliant
- Installs with ArcSDE under ‘SDE’ schema
- Default geometry storage
- Spatial index: Rtree using GiST framework
- Geometry stored as: compressed shape
- Geometry subtypes implemented as domains
Storage Types and Data Loading

SQL API: Type Functions

SQL Functions to store, access and analyze spatial data

- **Constructor:**
  - `st_geometry`, `st_point`, `st_linefromwkb`...

- **Accessor:**
  - `st_astext`, `st_binary`...

- **Analytical:**
  - `st_contains`, `st-touches`, `st_within`...
  - `st_buffer`, `st_union`, `st_difference`...
Storage Types and Data Loading

User Defined Spatial Storage Types

**GEOMETRY**

- OGC Compliant
- Installs with PostGIS under ‘PUBLIC’ schema
- Use PG_GEOMETRY keyword
- Spatial index: Rtree using GiST framework
- Geometry stored as: wkb
- Geometry subtypes implemented as constraints
Storage Types and Data Loading

User Defined Spatial Storage Types

ST_RASTER

- New at 10.0
- Must be installed separately
  - `sdesetup -o install_st_raster ...
- SQL Raster functions
  - Load and edit raster data
  - Export raster data to GeoTIFF file
  - Build raster pyramids and mosaic

Refer to ‘What is the ST_Raster storage Type’
Data Loading Tools

- **ArcGIS Desktop**
  - Import GP Tool
  - Simple Data Loader
  - Object Loader
  - Append GP Tool

- **ArcSDE admin commands**
  - shp2sde, sdeimport

- **SQL Commands**
  - create table, ...
  - st_register_spatial_column()‡ use ESRI SRID
  - addgeometrycolumn()‡ use EPSG SRID
Storage Types and Data Loading

Registering Existing Spatial Data with Geodatabase

• Only ArcGIS supported data types allowed
  - no bigint, arrays, ...

• Register with ArcSDE
  - sdelayer -o register ...

• Register with Geodatabase

• Register as Versioned
  - For multi-user editing

• Add Global IDs
  - For Geodatabase Replication
Storage Types and Data Loading

Controlling Data Storage

- Use configuration keyword to control object placement
  - Stored in `sde.sde_dbtune`
  - Specify during loading
- DBTUNE parameters sets:
  - Tablespace for indices & tables
  - Index configuration parameter
  - Spatial storage type(s)
- Default geometry storage:
  - `ST_GEOMETRY`
Start After Demos
Agenda

• ArcSDE Technology Overview
• Installation and Configuration
• Connecting to the Geodatabase
• Users and Privileges
• Storage Types and Data Loading
• Geodatabase Maintenance
  – Tuning
  – Data Migration
  – Upgrade
  – Backup and Restore
  – Troubleshooting
• Additional Resources
Geodatabase Maintenance

Tuning the Geodatabase

- Compress versioned geodatabase
  - Removes unreferenced rows
  - Improves versioned query performance
- Use DBTUNE keywords
  - Configure:
    - Tablespace
    - Indices
Geodatabase Maintenance

Tuning the PostgreSQL Database

• Vacuum Analyze is enabled by default
  - Vacuum disposes of unreferenced records
  - Analyze updates statistics

• Adjust PostgreSQL configuration settings
  - shared_buffers
  - work_mem
  - effective_cache_size
Geodatabase Maintenance

Data Migration

- Geodatabase Migration
  - Copy/paste in ArcCatalog
    - To and from geodatabases
  - sdeexport/sdeimport commands
    - From sdeexport (backup)
  - Data reload from original source
    - From file formats

- Database migration
  - From PostgreSQL to PostgreSQL:
    - Backup and Restore
Geodatabase Maintenance

Upgrade

- **Backup**
  - database
  - customized ArcSDE configuration files *(dbinit.sde, dbtune.sde)*

- **Stop ArcSDE services**
  - Use *sdeservice -o list* to list existing services

- **Uninstall existing ArcSDE software**
  - Allow installer to delete services and recreate after upgrade

- **Upgrade PostgreSQL 8.3.0 to PostgreSQL 8.3.8 or 8.4.1**

- **Install ArcSDE 10**
Geodatabase Maintenance

Upgrade

• Use ArcCatalog or Python script to run Upgrade Geodatabase
  - Replaces upgrade from Post-Installation wizard and sdesetup -o upgrade
  - Permission required: superuser privilege for SDE user
  - Requires direct connect access to geodatabase
  - Pre-requisite check determines if geodatabase is upgradable
    - See ‘Preparing to upgrade a geodatabase in PostgreSQL’ for a full list of requirements

• Recreate ArcSDE services
Geodatabase Maintenance

Backup and Restore

- Backup database, no single table backup
- Database Backup
  1. Create a backup of the entire database
  2. Create new database
     - Set search_path variable to user, public, sde schemas
     - With PostGIS use the template_postgis
     - DO NOT USE a geodatabase as a template
  3. Restore the contents of the public schema
  4. Restore the entire database

```
pg_restore.exe -n public -v "c:\db_name.dump.backup"
pg_restore.exe -v "c:\db_name.dump.backup"
```

Refer to: Technical Article 36522
Geodatabase Maintenance

Troubleshooting

• ArcSDE Error logs
  - sde_<service>.log
  - giomgr_<service>.log
  - Intercept (Defined in dbinit.sde)
    - set SDEINTERCEPT=crwtf
    - set SDEINTERCETPTLOC=C:\intercept

• PostgreSQL Error logs (Defined in postgresql.conf)
  - log_min_duration_statement = 25
  - log_duration = on
  - log_line_prefix = '%t [%p]: [%l-1] '
  - log_statement = 'all'
  - stats_start_collector = on

• Use PGFouine to analyze performance log files
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• Geodatabase Maintenance
• Additional Resources
  – PostgreSQL, ArcSDE, Technical Articles
  – Geodatabase Island
  – UC Events and Sessions
Additional Resources

• **ArcSDE and PostgreSQL Resources:**
  - [Geodatabase in PostgreSQL](#)
  - [Geodatabase & ArcSDE Forums](#)
  - [PostgreSQL Documentation](#)
  - [PostgreSQL Wiki](#)
  - Help in pgAdmin III

• **Technical Articles:**
  - 35128: Install PostgreSQL, ArcSDE, and PostGIS on Windows
  - 35385: Create a new user in PostgreSQL using psql
  - 35488: Set up PostGIS and ArcSDE geodatabase on Linux
  - 35891: The process cannot access the file because it is used by another process
  - 36522: Backing up and restoring geodatabases in PostgreSQL may cause errors
  - 36684: Grant group and role privileges in PostgreSQL
  - 37828: Install ArcSDE for PostgreSQL on SUSE 10
Other Geodatabase Resources

Geodatabase Resource Center- [http://resources.esri.com/geodatabase/](http://resources.esri.com/geodatabase/)

Inside the Geodatabase Blog- [www.esri.com/geodatabaseblog](www.esri.com/geodatabaseblog)
Other Sessions

Technical Workshops

• An Introduction to the Geodatabase
  - Wednesday 1:30pm Room 6C

• Managing Distributed Data with Geodatabase Replication
  - Tuesday 3:15pm Room 6D
  - Thursday 10:15am Room 4

• Editing Strategies for Enterprise Geodatabases
  - Thursday 10:15am Room 5A/B

• The Road Ahead – ArcGIS 10.1 Overview
  - Wednesday 1:30pm Room 10

• Road Ahead – ArcGIS Server 10.1
  - Tuesday 1:30pm Room 10
  - Thursday 8:30am Room 10
Other Sessions

Demo Theatre Presentations

- Using SQL with your Geodatabase
  - Thursday 10:30am Geodatabase Management Demo Theatre
Other Sessions

Technical Workshop 20 Minute

- What is a Geodatabase?: Tuesday 1:55pm Room 6B
- Migrating Data to the Geodatabase
  - Wednesday 3:40pm Room 6B
- Database Security Tips: Thursday 10:15am Room 23B
- Troubleshooting Performance Issues with Enterprise Geodatabases
  - Thursday 10:40am Room 24A
- Python – Automating Geodatabase Administration
  - Thursday 11:05am Room 24A
Other Sessions

Technical Workshop 20 Minute

- Upgrading ArcGIS 10.0 Geodatabases to 10.1
  - Thursday 1:30pm Room 23B
- Using Spatial Data in ArcGIS with Query Layers
- Thursday 1:55pm Room 23B
- Leveraging the Cloud for Data Sharing Between Remote Offices: Thursday 2:20pm Room 23B
- Implementing Database Roles in the Enterprise Geodatabase: Thursday 3:15pm Room 3
Other Sessions

Technical Workshop 20 Minute

- Enterprise Geodatabase Administration – Tips and Tricks: Thursday 3:40pm Room 3
- Enterprise Geodatabase Administration – Tips and Tricks
  - Thursday 3:40pm Room 3
- Road Ahead – GDB Admin: Thursday 3:40 Room 27BT
- Road Ahead – Geodatabase: Thursday 9:20am Room 6B
Thank You

Please fill out the workshop evaluation

Questions?