Esri International User Conference | San Diego, CA

Technical Workshops | July 12 - 15, 2011

Introduction to ArcSDE for PostgreSQL

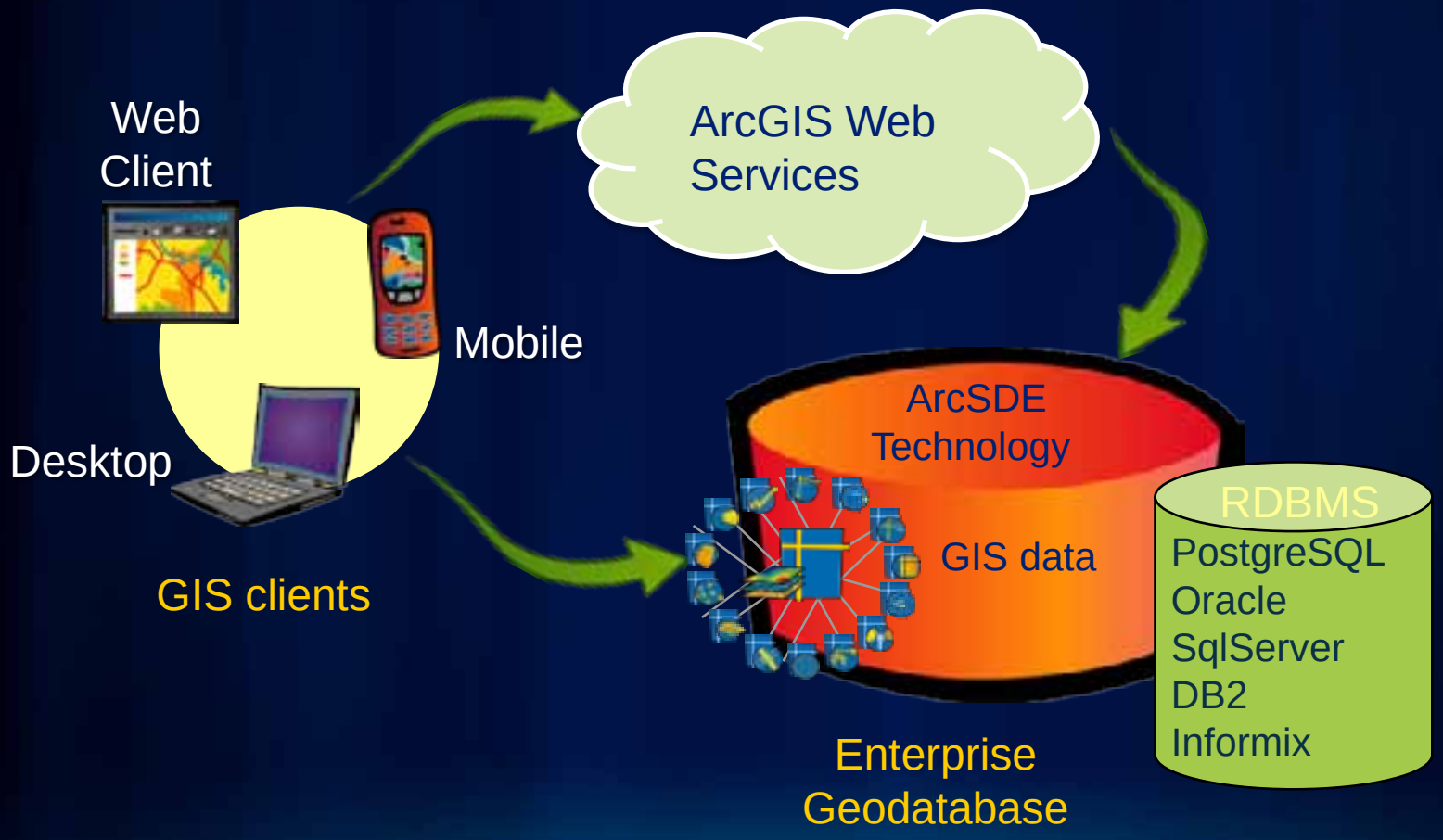
Kasia Tuszynska & James Gough

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



ArcSDE Technology Overview

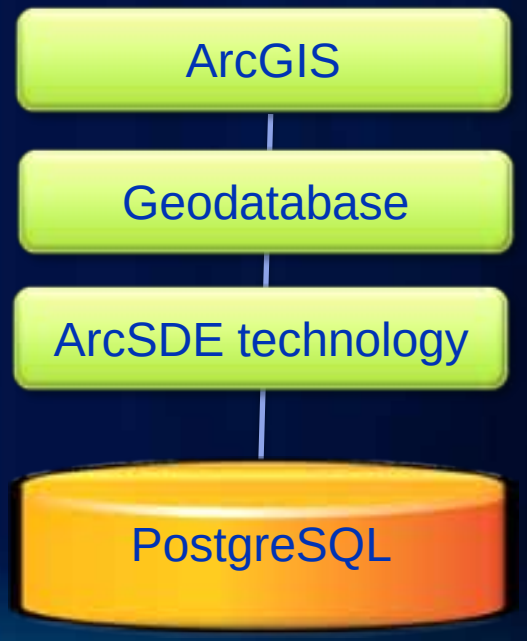
Defining the Geodatabase

- 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

ArcSDE Technology Overview

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 Overview

ArcSDE 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**

http://wikis.esri.com/wiki/display/ag93bsr/ArcSDE+PostgreSQL+Database+Requirements

Platforms	ArcSDE 9.3	ArcSDE 9.3.1	ArcSDE 10
RHEL4 32-bit	YES	YES	NO
RHEL4 64-bit	NO	NO	NO
RHEL5 32-bit	NO	NO	YES
RHEL5 64-bit	NO	NO	YES
SUSE 10 32-bit	YES	YES	YES
SUSE 10 64-bit	NO	NO	YES
WIN 2003 32-bit	YES	YES	YES
WIN 2008 32-bit	YES	YES	YES
WIN 2008 64-bit	NO	NO	YES

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

AMI ID	Source
ami-92738cfb	248675906072/Esri ArcGIS Server 10.0 Service Pack 2 (May 2011)
ami-cac837a3	248675906072/Esri ArcGIS Enterprise Geodatabase 10.0 Service Pack 2 (May 2011)

Demo

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

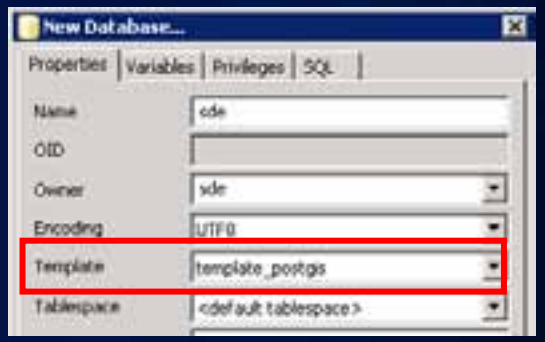
Installing on Windows

- 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 …;`

ü Refer to: Technical Article 35128

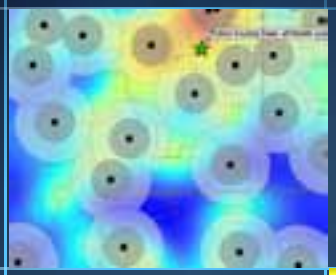
Installation and Configuration

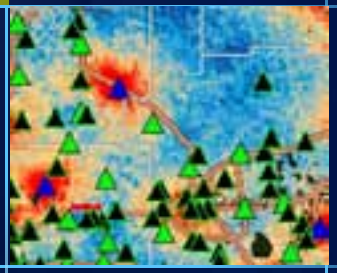
Installing on Linux

1. **Install PostgreSQL (*RPM or source*)**
   - **create_pgdb.sde - run as root user (*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 (*RHEL only*)**
4. **Install ArcSDE**
   - `install –load`

ü **Technical Article 35488-to install ArcSDE & PostGIS on Linux**

ü **Technical Article 37828-to install ArcSDE on SUSE 10**





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**

```
# - Connection Settings –
listen_addresses = '*'
```

  - **pg_hba.conf**

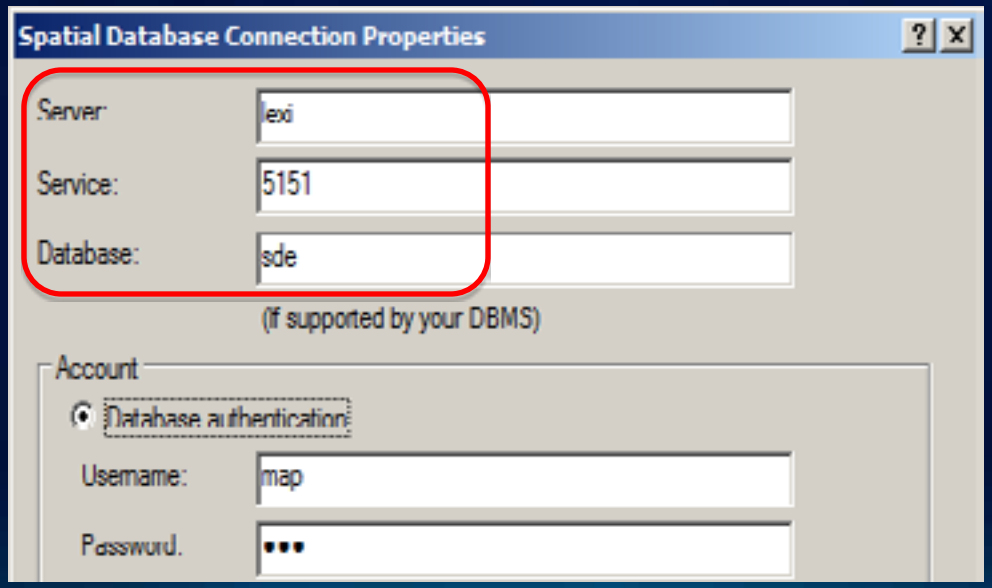
```
# TYPE    DATABASE    USER    CIDR-ADDRESS METHOD
# IPv4 local connections:
  host    all         all     127.0.0.1/32  md5
  host    all         all     10.0.0.0/8    md5
```

- **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

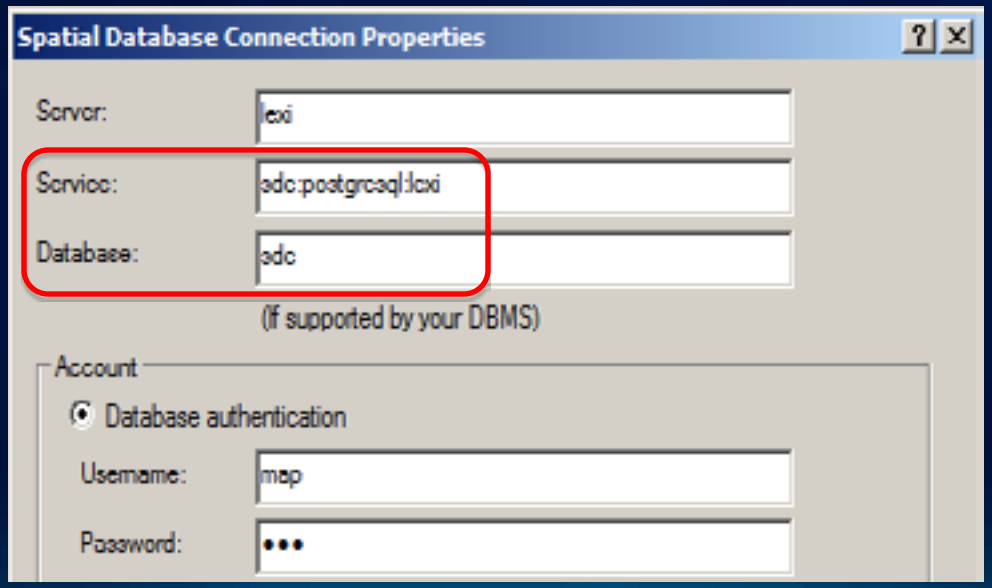
- ArcSDE service is running
- Enter ArcSDE port number or name in Service field



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



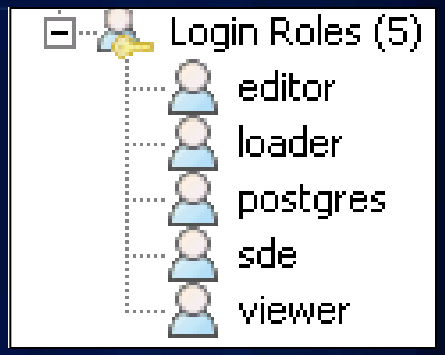
Agenda

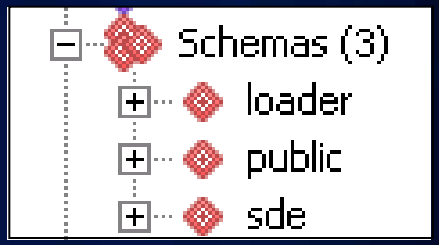
- ArcSDE Technology Overview
- Installation and Configuration
- Connecting to the Geodatabase
- Users and Privileges
  - Creating Users
  - PostgreSQL Schemas
  - SDE User and Data Owners
  - Data Editors and Data Viewers
- Storage Types and Data Loading
- Geodatabase Maintenance
- Additional Resources

Users and Privileges

Creating Users

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

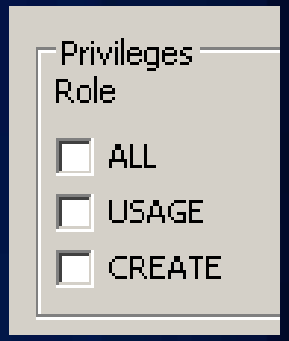




- Types of users:
  - PostgreSQL superusers: postgres, sde
  - Data Owners, Data Editors, Data Viewers

Users and Privileges

Creating Users

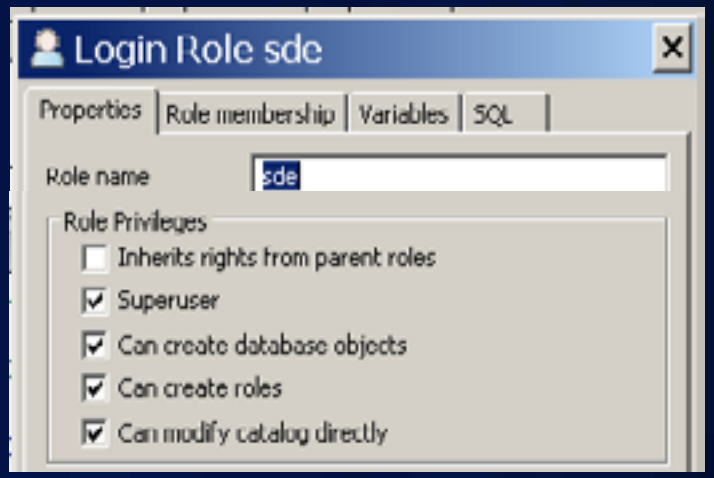


- Create schemas for users that own data
  - SDE user – ArcSDE system tables
  - Data owner – user data
- ArcSDE requirement: schema name = user name
- PostgreSQL specific schema privilege: USAGE
  - Allow execution of functions in schema
  - Allow non-data owners to access data
  - Grant usage to login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

```
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;
```

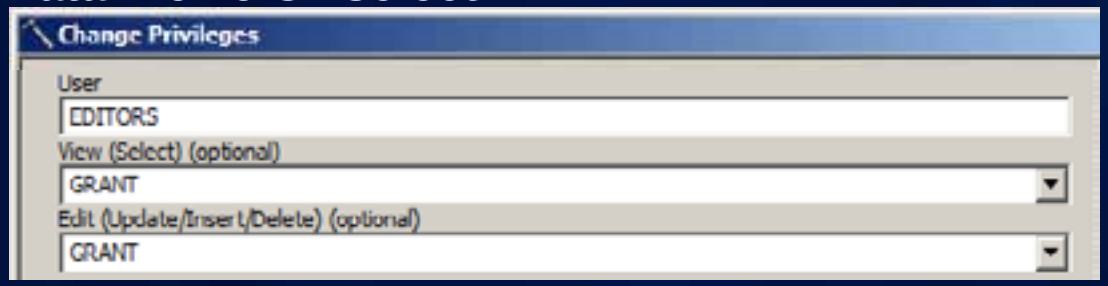
ü **See SQL script example in:**

sdehome/tools/postgres > roles_schema_privileges.sql

Users and Privileges

Data Editors and Data Viewers

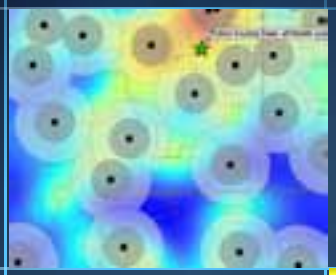
- Grant data privileges in ArcGIS or ArcSDE as Data Owner
  - Data Editors: select, update, insert, delete
  - Data Viewers: select

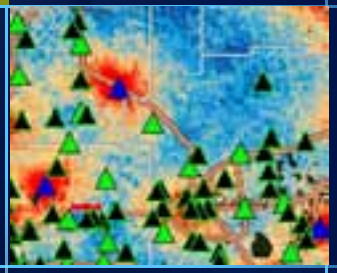


- Can be in a group role as an option
  - Each user has a login role and added to a group role
  - Grant inherit privileges at login role

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

ü Refer to: Technical Article 36684





Creating Users
Granting Privileges

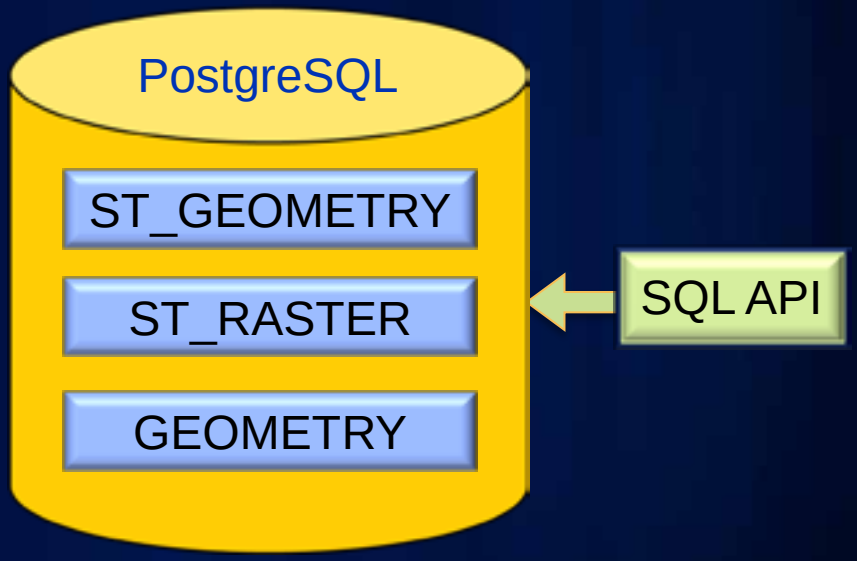
Agenda

- 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

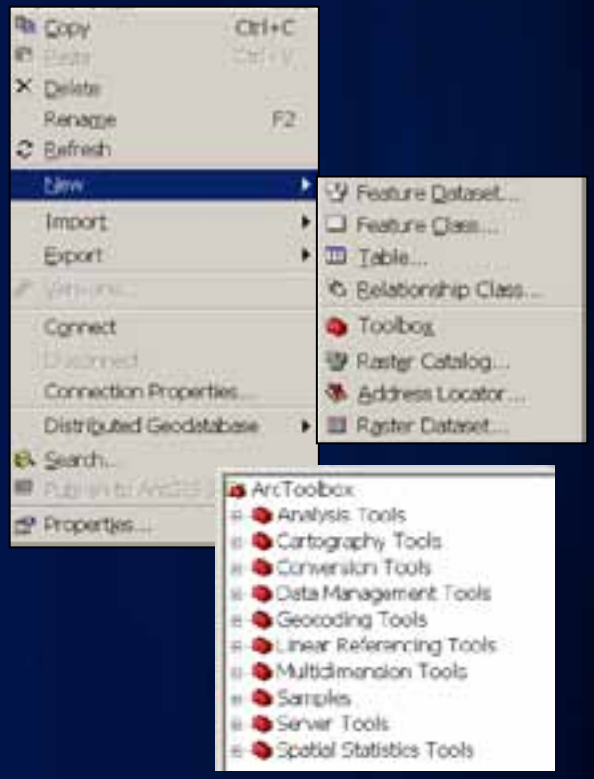
ST_RASTER

- 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

ü Refer to ‘What is the ST_Raster storage Type’

Storage Types and Data Loading

Loading Data into the Geodatabase



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()` à use ESRI SRID
  - `addgeometrycolumn()` à use EPSG SRID

Storage Types and Data Loading

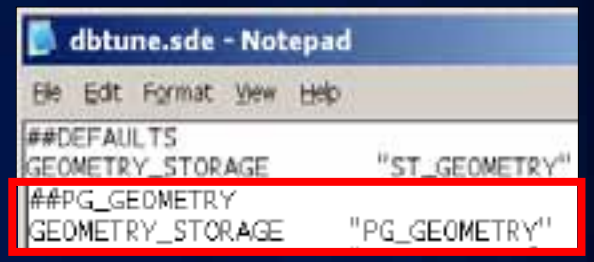
Registering Existing Spatial Data with Geodatabase

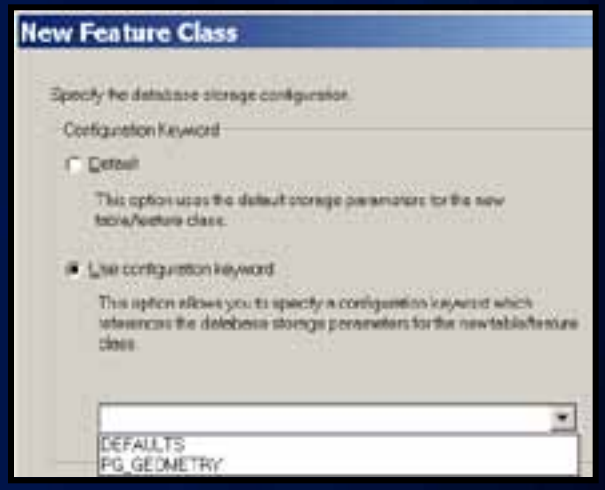
- Only ArcGIS supported data types allowed
  - no bigint, arrays, …
- Register with ArcSDE
  - `sdelayer –o register …`
- Register with Geodatabase
- Register as Versioned
  - For multi-user editing
- Add Global IDs
  - For Geodatabase Replication

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






```
B_INDEX_USER     "WITH (FILLFACTOR = 75)"
#B_INDEX_USER     "WITH (FILLFACTOR = 75) USING INDEX TABLESPACE <name>"
B_STORAGE        ""
#B_STORAGE        "TABLESPACE <name>"
```

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:
    - Tablespaces
    - 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”
```

ü Refer to: Technical Article 36522

Geodatabase Maintenance

Troubleshooting

- **ArcSDE Error logs**

  Address C:\Program Files\ArcGIS\ArcSDE\pgexe\etc

  - **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**

  Address C:\Program Files\PostgreSQL\8.3\data\pg_log

- **Use PGFouine to analyze performance log files**

Agenda

- ArcSDE Technology Overview
- Installation and Configuration
- Connecting to the Geodatabase
- Users and Privileges
- Storage Types and Data Loading
- Geodatabase Maintenance
- Additional Resources
  - PostgreSQL, ArcSDE, Technical Articles
  - Geodatabase Island
  - UC Events and Sessions

Additional Resources

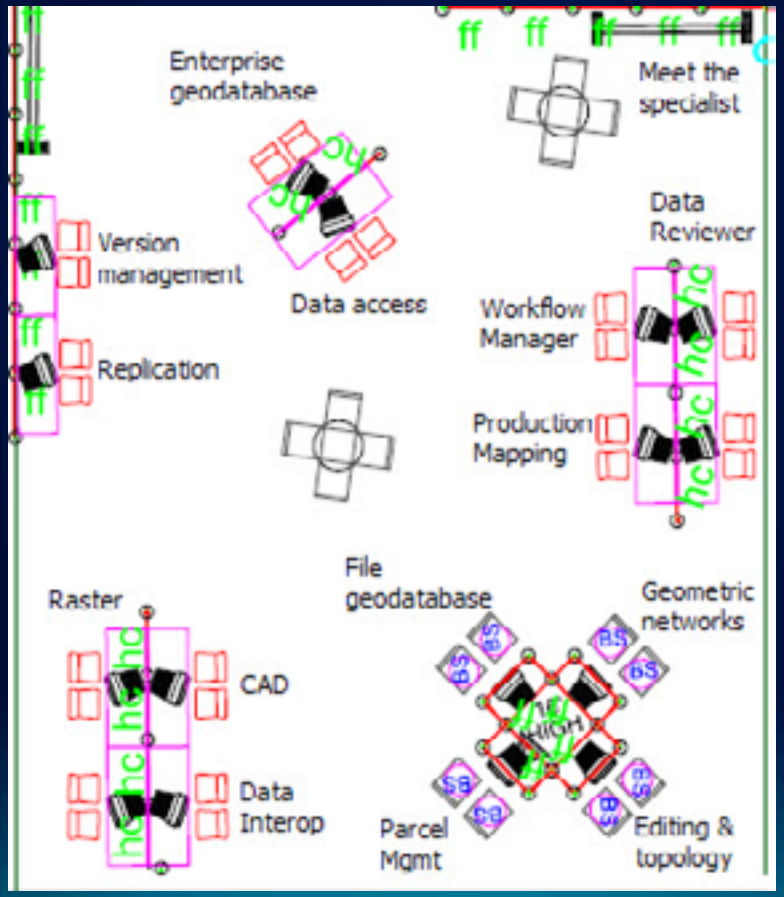
- **ArcSDE and PostgreSQL Resources:**
  - Geodatabase in PostgreSQL
  - Geodatabase & ArcSDE Forums
  - PostgreSQL Documentation
  - PostgreSQL Wiki
  - Help in pgAdmin III

- **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/

Inside the Geodatabase Blog-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 Geodatabses
  - 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 23BLeveraging 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?

esri