Administering Your Oracle Geodatabase

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A few questions…

• How many were at last year’s User Conference and attended this session?
• How many are using Oracle 10g, 11g, 12c?
• How many installing arcSDE and using application server – port 5151?
• Who are you? DBA’s, GIS Manager’s
• Experience – brand new?
Agenda

• Where do I start…
  - Configure Oracle to support geodatabases?
  - Create geodatabases?
  - Control access to my data?
  - Store spatial data?
  - Make sure that my data is safe?
  - Maintain good performance?

• News since the last UC
How do I…?
Common questions when working with Oracle databases and geodatabases
How do I... configure Oracle to support geodatabases?
How do I configure Oracle to support geodatabases?

- Install a supported version of Oracle
  Oracle database requirements for ArcGIS 10.3.x
- Install Oracle Text Option
- Execute privileges on packages
  - dbms_lob, dbms_lock, dbms_pipe, dbms_utility, dbms_sql, utl_raw, dbms_crypto (sde user only)…
  - after Geodatabase is enabled some privileges can be restricted
Supported versions at 10.3/10.3.x

- **Standard/Standard One/Enterprise Editions:**
  - Oracle 10g R2 (64-bit) 10.2.0.3
  - 10.3.x does not support use of 10g Oracle Client
  - 10.3.x last release to support 10g
  - Oracle 11g R2 (64-bit) 11.2.0.3
  - Oracle 12c R1 (64-bit) 12.1.0.1
  - Oracle Text Component must be installed

- **Operating System Support (as supported by Oracle version):**
  - Windows 2008R2, 2012
  - Redhat and Oracle Linux 5,6,7
  - SUSE Linux 10,11
  - Solaris 10,11
  - AIX 6.1, 7.1
Oracle 12c Multitenant

Pluggable databases

- At 12c Geodatabase can be in
  - Traditional 12c instance or
  - 12c pluggable database not container

- Can provide
  - Rapid provisioning and cloning
  - Staging for patching and upgrades
  - Consolidation and unified management

- Does require additional licensing if Container Database (CDB) contains more than two Pluggable Databases (PDB)

- Up to 252 PDB’s in a single CDB

- e.g. create pluggable database pdbgdb_clone from pdbgdb;
• Oracle 11g R2 or Oracle 12c database client must be used to connect to Oracle 10g R2.

• Oracle Linux supported based on source and binary compatibility with Redhat Enterprise Linux

• Exadata support based on Oracle Linux and RAC compatibility.

• While 11.2.0.3 is the 11g base supported version, there are several issues customers have encountered. Therefore, Esri recommends moving to 11.2.0.4.

• Oracle 10.2.0.3 ST_GEOMETRY users need to apply Oracle Patch that fixes Oracle bug 6756089.
Memory and Initialization Parameters

• Memory Tuning
  - SGA must not swap (2/3 RAM or less)
  - Avoid excessive paging (SGA too large)
  - Configure enough virtual memory (3-4 times RAM), avoid excessive paging
  - Explicit quotas on tablespaces (avoid running out of space)

• Initialization Parameters
  - OPEN_CURSORS (2000 or higher - consult ArcGIS online help)
  - SESSION_CACHED_CURSORS (minimum of 50, 50-150)
  - SESSIONS and PROCESSES
    (Geodatabase Connections parameter not applicable at 10.3 and higher)

• UNDO_POOL
  - Resource manager plan directive, can be set to allow for unlimited undo pool for SDE user (set up a consumer group) for large compress operations
Oracle Client Notes

- 32 bit or 64 bit as needed
  - Desktop and Engine 32 bit
  - Server and Pro 64 bit
- Instant, Runtime or Admin client
- Set PATH to client libraries
- TNSNAMES.ora file
  - Important for Easy Connect configurations
- SQLNET.ora file

<table>
<thead>
<tr>
<th>server name/service name (or ID)</th>
<th>dbsrvr/orcl</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP address of server/service name (or ID)</td>
<td>10:10:10:10/orcl</td>
</tr>
<tr>
<td>server name:port/service name (or ID)</td>
<td>dbsrvr:60000/orcl</td>
</tr>
<tr>
<td>service name if default instance in listener</td>
<td>orcl</td>
</tr>
</tbody>
</table>
Managing Connections

- ArcGIS Desktop
- Python

```python
arcpy.ListUsers(r"c:\temp\oragdb.sde")

[user(ClientName=u'PC4', ConnectionTime=datetime.datetime(2014, 2, 18, 8, 30, 19), ID=18, IsDirecConnection=True, Name=u'publisher1')]

[user(ClientName=u'PC25', ConnectionTime=datetime.datetime(2014, 2, 21, 14, 10, 43), ID=33, IsDirecConnection=True, Name=u'editor2')]

arcpy.DisconnectUser(r"c:\temp\oragdb.sde",33)

The user session will be immediately dropped from the geodatabase.
```
Configuring the Oracle Instant Client

Amit Kesarwani
Connection failed
Add instant client directory location to "Path" environment variable and "Tns_admin" env variable
Manually add tnsnames.ora and sqlnet.ora in the Instant client
Connection using Ezconnect syntax – “server/instance”
Connection using Tns name

Database Connection

Database Platform: Oracle

Instance: GDS103_instant

Authentication Type: Database authentication

User name: map

Password: [hidden]

Save user name and password

About Database Connections

OK Cancel
Connection successful
How do I... create geodatabases?
Databases and Geodatabases

• An Oracle database lives in an Oracle instance
  - 10g and 11g there is a single database per instance
  - 12c introduced multi-tenant with pluggable databases
    (additional cost if more than 1)

• A geodatabase is an ArcGIS construct hosted in a database
Database vs. Geodatabase
Behaviors, Complex Features, Versioning and Distributed Data

• Database provides
  - Transaction Management
  - Authorization/Security
  - Data Management
  - Spatial Types
  - Backup

• Enterprise Geodatabase is an Oracle Database with an Administrative Schema providing
  - Behaviors
  - Complex Features (Topologies, Networks, Parcel Fabrics, etc…)
  - Versioning (Long Transactions)
  - Distributed Data
  - Archiving
Multiple Geodatabase in Oracle

Multiple Instances, 12c Multi-Tenant, Schema Geodatabase

- Multiple Instances
- 12c Pluggable Database
- Schema *(special cases)*
Enabling (or Creating) Geodatabase

• Use GP Tools (or python) to enable (or create) geodatabases
• It is more typical with Oracle that instance/database will already be present
• Enable geodatabase tool
  - Create a geodatabase in an existing database, without sysadmin privileges
• Create geodatabase tool
  - Creates SDE user and tablespace, requires SYS
Logfile Table Architecture

• Architectures
  - Shared
  - Session
  - Pools owned by GDB admin
  - Configure Geodatabase Log File tool

• Shared is default for Oracle
  - User must have create table, create session and create sequence
  - Could be contention if many users connect with same name.

• Pool owned by GDB admin
  - good if users are read-only
  - many users connect with same user name (e.g. publication server)
Controlling Storage

- Configuration keyword and parameters storage type, location, etc…
  - adjust for backup requirements, activity, size of segment (table, index)
- To create a keyword:
  - Export DBTUNE table to a file, edit it and import back
    - sdedbtune –o export/import or alter
  - VARCHAR vs. NVARCHAR
  - UNICODE_STRING

SDE.SDE_DBTUNE
- table for storing keywords and associated parameters
Upgrading the Geodatabase

• Test in a staging or test environment first
• New st_shapelib library
• Upgrade
  - ArcGIS GP tool or Python script
• Backup configuration – dbinit.sde and dbtune.sde
  - Server_config and dbtune tables in sde schema
  - compare previous version to new
• Check geometry storage type, consider migration
• OS – Oracle – GDB – test between if possible
• Existing GDB check automatic
• Clean DBMS_PIPE - Values in the database pipe can cause connection problems
• Review existing workflow, application and service impacts
Enabling a Geodatabase

Amit Kesarwani
Example – Create Enterprise Geodatabase
Example – Enable Enterprise Geodatabase
Using Python

Enable -

```python
import arcpy

arcpy.EnableEnterpriseGeodatabase_management("C:\Users\amit5815\AppData\Roaming\Esri\Desktop10.3\ArcCatalog\ora_nine2_gdb103_sde.sde", "C:\\Server_Ent_Adv.ecp")
```

Create -

```python
  
  "C:\\Server_Ent_Adv.ecp")
```
How do I... store spatial data?

And take advantage of spatial data types...
Geometry Storage
Spatial Types and Functions

• Creation of Features through SQL
• Analysis through SQL
• Geodatabase behavior **not supported** through SQL

Oracle

```sql
SELECT sa.id SA_ID, hs.id HS_ID
FROM SENSITIVE AREAS sa, HAZARDOUS SITES hs
WHERE sde.st_intersects (sde.st_buffer (hs.site, .1), sa.shape) = 1
ORDER BY sa.id;
```

<table>
<thead>
<tr>
<th>SA_ID</th>
<th>HS_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>
Geometry Storage
Default Storage Type – ST_GEOMETRY

- ST_Geometry – ESRI Spatial Type
- User Defined Type (UDT) used to store geographic features
- Allows access to spatial data through SQL functions
- Efficiency - Automatic geometry validation
- Conforms to ISO and OGC standards
- Available since ArcSDE 9.2, became default at 9.3

```
SQL> desc gdb.streets_st_geom
  Name ________________________________ Null? _______ Type
------------------------------- _______ ________________________
OBJECTID ___________________________ NOT NULL NUMBER<38>
CFCC _____________________________ VARCHAR2<3>
SHAPE ____________________________ SDE.ST_GEOMETRY
```
ST_Geometry spatial type configuration

- `st_shapelib` library
- `extproc.ora (11g) or listener.ora/tnsnames.ora configuration`
Configure External Library – st_shapelib

- 11g use extproc.ora located in ORACLE_HOME\hs\admin directory
  - EXTPROC_DLLS=ONLY:C:\mylibraries\st_shapelib.dll (Windows)
  - EXTPROC_DLLS=ONLY:/user/esrilibs/libst_shapelib.so (Unix)

- 10g – Listener.ora and Tnsnames.ora

  SID_LIST_LISTENER =
  (SID_LIST =
   (SID_DESC =
     (SID_NAME = PLSExtProc)
     (ORACLE_HOME = /servit/oracle/product/10.2.0/db_1)
     (PROGRAM = extproc)
     (ENVS="EXTPROC_DLLS=/servit/ArcSDE/sdeexe/lib/libst_shapelib.so")
   )
  )
Configuring the ST_Geometry External Library

Amit Kesarwani
Simple sql to query a point – Fails, `st_geometry` alias points to `MDSYS.SDO_GEOMETRY`
Create spatial type in the oracle database using geoprocessing tool
Or Create spatial type in the oracle database using python

C:\>set ORACLE_HOME=C:\instantclient_11_2
C:\>set path=%ORACLE_HOME%;%PATH%
C:\>C:\python27\arcpy\arcpygis10.3\python.exe
Python 2.7.8 (default, Jun 30 2014, 16:03:49) [MSC v.1500 32 bit (Intel)] on win32
Type 'help', 'copyright', 'credits' or 'license' for more information.
>>> #Import Arcpy module
... import arcpy
>>> arcpy.CreateSpatialType_management("C:\\Users\\amit5815\\AppData\\Roaming\\ESRI\\Desktop10.3\\ArcCatalog\\ora nine_nongdb_sys.sde", "sde", "sde", "C:\\Program Files (x86)\\ArcGIS\\Desktop10.3\\DatabaseSupport\\Oracle\\Windows64\\st_shapelib.dll")
<Result 'C:\\Users\\amit5815\\AppData\\Roaming\\ESRI\\Desktop10.3\\ArcCatalog\\ora nine_nongdb_sys.sde'>
>>>
After installing Spatial Type – sde owns st\_geometry spatial type
Error showing extproc agent doesn’t know the path.

SQL> Select sde.st_geometry('point (1 1)', 4326) from dual;
ERROR at line 1:
ORA-28595: Extproc agent : Invalid DLL Path
ORA-06512: at "SDE.ST_GEOMETRY_SHAPELIB_PKG", line 12
ORA-06512: at "SDE.ST_GEOMETRY", line 35

SQL> select * from user_libraries;
LIBRARY_NAME
FILE_SPEC
FILE_STATUS
AGENT
LEAF_FILENAME
ORIGIN_CON_ID
ST_SHAPELIB
C:\Progra-2\ArcGIS\Desktop10.3\DatabaseSupport\Oracle\windows64\st_shapelib.dll
VALID
Add path to extpro.ora

```plaintext
Syntax: SET EXTPROC_DLLS=DLL:DLL
# * ANY
when EXTPROC_DLLS=ANY, DLL checking is disabled.
# * Syntax: SET EXTPROC_DLLS=ANY

SET EXTPROC_DLLS=ONLY:C:\\progra-2\\arcsis\\desktop10.3\\databasesupport\\oracle\\windows64\\st_shapelib.dll
```
Query works now

C:\>sqlplus sde@sde@nine2/mongdb
SQL*Plus: Release 12.1.0.2.0 Production on Mon Jul 20 17:05:46 2015
Copyright (c) 1982, 2014, Oracle. All rights reserved.
Last Successful login time: Mon Jul 20 2015 17:05:39 -07:00
Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options

SQL> set pages 9999
SQL> Select sde.st_geometry('point (1 1)', 4326) from dual;
SDE.ST_GEOMETRY('POINT(1 1)',4326)(ENTITY, NUMPTS, MINX, MINY, MAXX, MAXY, MINZ,
ST_GEOMETRY(1, 1, 1, 1, 1, NULL, NULL, NULL, NULL, NULL, 0, 0, 4326, '0C00000001000080A8B3D7AB1780A8B3D7AB17')

SQL>
SQL>
Extproc for a another version of Geodatabase – Path to shape lib is different
Add path to 10.2.2 version of shape lib to extproc.ora

```
SET EXTPROC_DLLS= C:\progra-2\arcgis\desktop10.3\DatabaseSupport\Oracle\windows64\st_shapelib.dll; C:\progra-2\arcgis\desktop10.2\DatabaseSupport\Oracle\windows64\st_shapelib.dll
```
Query works now
SDO_Geometry: native Oracle spatial type

- Locator or Spatial
- Validation is not the same between ArcGIS and SDO_Geometry
- Spatial reference metadata synchronization between SDE and MDSYS administrative schemas
- SDO_ETYPE 0 data
- All data in column must be same coordinate system
- LRS implementations differ
- Modifications of complex features only through ArcGIS
- Test any custom programming carefully
SDO_Geometry prerequisites

• be owned by the user registering the table.
• have a single SDO_GEOMETRY column.
• have no other columns of a user-defined type.
• have a valid entry in the view USER_SDO_GEOM_METADATA.
• have a single type of geometry (points, lines, or polygons), can be multipart.
• have an integer, unique, not-NULL column suitable as a registered row ID column.
• should have a spatial index.
• should pass Oracle’s geometry validation tests.
• All spatial records must have not-NULL valid number values in the SDO_ORDINATES array.
How do I control access to my data?

Access to Oracle objects are managed with permissions granted to users and roles.
Oracle Users and Roles

• **Authentication**
  - Oracle User vs. External Authentication

• **Authorization – Privileges**
  - What can a user do in the database?
  - Admin (SDE) & Data Owner (DDL)
    - Use ArcGIS to grant object level privileges in Geodatabase
  - Editors (DML), Viewers
  - Roles

• **Schemas (Data Owners) = Containers**
  - What are logical groups of database objects that should be managed as a whole?
## User Privileges

<table>
<thead>
<tr>
<th>Type of user</th>
<th>Database privileges</th>
<th>Dataset privileges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data viewer</td>
<td>CREATE SESSION</td>
<td>SELECT on database objects</td>
</tr>
<tr>
<td>Data editor</td>
<td>CREATE SESSION</td>
<td>SELECT, INSERT, UPDATE, and DELETE on other users' datasets</td>
</tr>
<tr>
<td>Data creator</td>
<td>CREATE SESSION CREATE SEQUENCE CREATE TRIGGER CREATE VIEW CREATE TABLE</td>
<td></td>
</tr>
<tr>
<td>Geodatabase administrator</td>
<td>CREATE SESSION CREATE SEQUENCE CREATE TABLE CREATE TRIGGER CREATE PROCEDURE</td>
<td></td>
</tr>
</tbody>
</table>
Additional Privileges

• review online help – search “Oracle Privileges”
• SDE user
  - to create GDB in SDE and upgrade master GDB
• Other users
  - to create and upgrade user-schema GDB
• Optional Privileges to
  - enable SQL tracing
  - monitor Oracle and basic troubleshooting
  - integrate with other non-spatial databases
  - manage connections
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

• Creating a user with the Create User tool will grant permissions sufficient for creating data
Managing Permissions: Roles and Object Permissions

Amit Kesarwani
Create User

Create Database User

Input Database Connection:
Database Connections\ora\ora2\gdb103\sys.sql

Create Operating System Authenticated User (optional)

Database User:
user1

Database User Password (optional):

Role (optional):
editor

Tablespace Name (optional):
world_data
Create Role

Input Database Connection:
Database Connections/pra_inv2_odb103_ays.ods

Role:
editor

Grant To or Revoke From User(s) (optional):
GRANT

User Name(s) (optional):
user1, user2

OK Cancel Environments Show Help
Change Privileges

Input Dataset:
- Database Connections/pra nine2 gdb103_map.sde\MAP_SANGS_HYD_LAKE
- Database Connections/pra nine2 gdb103_map.sde\MAP_USA_web

User:
- User1

View (Select) (optional):
- GRANT

Edit (Update/Insert/Delete) (optional):
- GRANT
Object Privileges

When done using ArcGIS – Privileges are granted to related tables too
How do I... make sure my data is safe?
Backup
Backup – has it been tested?
Backup Options

- **Methods**
  - Recovery Manager (RMAN)
  - User Managed Backups – 3rd party
  - Data Pump Export/Import
- Backup all schemas, including SDE
- Test backup, use to refresh staging
- On restore, may have to compile SDE schema packages.
  - `DBMS_UTILITY.COMPILE_SCHEMA('SDE')`

*Note: It is worthwhile to backup dbinit file and dbtune settings whenever they change.*
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 system capable of being used in production**
How do I... maintain good performance?
How do I maintain good performance?

- **Standard maintenance**
  - Reconcile/Post/Compress
  - Rebuild Indexes
  - Calculate Statistics
- **Layer scale dependencies**
- **Other Best Practices**
Some of Top Discussion Topics and Directions

• **Performance**
  - Analyze if lots of transactional editing workflows
    - Watch certain tables and their growth during the day – state_lineages, etc…

• **Upgrades and Migrations**
  - Clone vs. export/import
    - Check Geometry Storage type and consider migrating to default ST_Geometry spatial type.
    - Test first.
  - Direct Connect

• **Deprecation of ArcSDE app server and command line tools @ 10.2.2**
  - SDE installs (app server, command line tools) ending at 10.2.2, not present in 10.3
  - Direct Connect will be used 10.3 forward, SDE libraries still present

• **Advanced Configurations and Topics**
  - Exadata
  - Oracle RAC and Dataguard
Managing Performance : Statistics

• Table and Index statistics
  - The distribution and contents of rows
  - What the optimizer uses to make execution plans
  - Information about the rows stored in IOTs, and other index metadata

• System statistics
  - Internal object statistics

• Update using Oracle or ArcGIS
• Update after editing and data loading
Monitoring: Why monitor?

• Establish performance benchmarks to measure impacts:
  - upgrades and patches
  - new applications or workflows
  - new server resources or deployment patterns

• Assist in troubleshooting
  - assist in isolating a problem when one takes place
Oracle RAC and Dataguard

• See updated KB Article 42292 – “FAQ: Does ArcGIS support Oracle RAC and TAF for highly available geodatabases?”

• Use Direct Connect architecture

• Extproc configuration for ST_Geometry spatial type
  - Install on each node

• Cursors
  - Cursors don’t failover

• Dataguard – standby database
  - Physical – “standby” typically
  - 10.3.1 – read-only Geodatabase connections
  - Logical – should be treated as read-only
    - Not supported, configuration complex due to SQL exclusion required.
Since last user conference...

**Read-Only Connection capability at 10.3.1 – Dataguard**
(Connection information not recorded, but any attempts on an operation that would result in a write, such as selecting more than 100 features in ArcMap, or querying more than 1000 OID’s within a map service query would fail)

**New Geodatabase Administration Geoprocessing Tools**
(ArcSDE Application Server, ArcSDE Command Line Tools and ArcSDE API’s no longer available at 10.3)

**October 2014 Oracle Security patch issue**
*Esri KB 43293 – can not connect after patch, 11.2.0.3, 11.2.0.4, 12.1.0.2*
Thank you...

Please fill out the session evaluation

Online – www.esri.com/ucsessionssurveys
Paper – pick up and put in drop box