Administering your Oracle Geodatabase

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A few questions…

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

- Requirements and Configuration
- Supported Versions
- Setup and Configuration
- Spatial Types
Requirements @ 10.2.x: Oracle Versions and Supported OS

tested and certified: verify at support.esri.com

- **64-bit DBMS and OS only** (10.1 and newer)
- Support begins at 10.2.1 for
  - Oracle 12c and Multitenant – GDB can be in pluggable database *not* container
  - Windows Server 2012 and Sun Solaris 11
- Windows Server 2003 and 2003R2 no longer supported at 10.2.2
Oracle 12c Multitenant

Pluggable databases

• Geodatabase can be in 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;
Setting up Oracle: Initialization Parameters

• Memory Parameters
  • Adjust as little as possible, let Oracle manage
  • SGA_TARGET – Automatic Shared Memory Management (ASMM)
    • multiple instances on same server – monitor
  • PGA_AGGREGATE_TARGET, DB_CACHE_SIZE, SHARED_POOL, LOG_BUFFER

• Optimizer Parameters
  • OPTIMIZER_MODE – default “ALL ROWS”

• Other Parameters
  • SESSIONS, PROCESSES and GDB Connections – make sure they match
  • UNDO_POOL enough for compress

• Cursor Configuration
  • OPEN_CURSORS = 2000
  • Tech Article #27024
Setting up Oracle: Packages

- Grant Execute to Public on
  - DBMS_PIPE
  - DBMS_LOCK
  - DBMS_LOB
  - DBMSUTILITY
  - DBMS_SQL
  - UTL_RAW

- Grant Execute to SDE on
  - DBMS_CRYPTO

- After GDB creation or upgrade, privileges can be restricted
Further Guidance Notes

- SGA must not swap
  - enough physical memory for all instances
- Avoid excessive paging
  - monitor
- Allocate enough virtual memory/paging file
  - Oracle recommends swap space be at least 3 to 4 times the size of your physical RAM.
- Use explicit quotas on tablespaces to avoid using up available storage.
- sessions, processes and connections
Checking Oracle Initialization Parameters

Enterprise Manager or SQL

```
SQL> show parameters

NAME                                      TYPE           VALUE
--------------------------------------------------------
07_DICTIONARY_ACCESSIBILITY               boolean        FALSE
active_instance_count                     integer        1
aq_tm_processes                           integer        0
archive_lag_target                        string         
asm_diskgroups                            string         
asm_diskstring                            string         
asm_power_limit                           integer        1
asm_preferred_read_failure_groups         string         E:\APP\ADMINISTRATOR\LADUMP
audit_file_dest                           string         
audit_sys_operations                      boolean        FALSE
audit_trail                               string         DB
awr_snapshot_time_offset                  integer        0
background_core_dump                      string         partial
background_dump_dest                      string         E:\app\Administrator
```
Setup and Configuration: Creating or Enabling via ArcGIS Desktop

- Geodatabase Administration
  - Analyze Datasets
  - Change Privileges
  - Compress
  - Create Database User
  - Create Enterprise Geodatabase
  - Create Role
  - Enable Enterprise Geodatabase
  - Migrate Storage
  - Rebuild Indexes
  - Register with Geodatabase
  - Upgrade Dataset
  - Upgrade Geodatabase
  - Upgrade Spatial Reference
Geodatabase and Administrative Schema

- Manage data through ArcGIS
  - Load, edit, delete, etc..
- Manage through tool that loads data.
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
Geodatabase Configuration: Connections

sde.server_config table

- Geodatabase connections
- Oracle sessions and processes
Geodatabase Architecture: Multiple Geodatabases

Multiple Geodatabase Configuration

- **Multiple Geodatabases in Oracle**
  - Multiple instances on same server
  - Multiple instances on different servers
  - Project/Schema Geodatabase

- **Reasons for multiple geodatabases**
  - Editing and publishing (web)
  - Production and Staging
  - Different application needs
  - Separate version management
Geometry Storage
Spatial Types and Functions

- Creation of Features through SQL
- Analysis through SQL

Oracle

```
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>
<tr>
<td>3</td>
<td>4</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

Other User Defined Spatial Types
- PostGIS Geometry
- SDO_Geometry (Oracle)
- SDO_GeoRaster (Oracle)
- Microsoft SQL Server Geometry
- Microsoft SQL Server Geography

```
SQL> desc gdb.streets_st_geom
Name ________________________________ Null? Type
OBJECTID ___________________________ NOT NULL NUMBER(38)
CFCC ______________________________ NUMBER
SHAPE ______________________________ SDE.ST_GEOMETRY
```
Spatial Type Functionality and Geodatabase Behavior

- External library (dll, so), Extproc set up for
  - Executing SQL commands on a ST_GeOMETRY column
  - For using ST_GeOMETRY operators
  - Definition and label queries inside ArcMap

- Geodatabase behavior not supported through SQL

Database
- Spatial Types
  - ST_Geometry
  - SDO_Geometry

Geodatabase
- Administrative Schema
- Behaviors
  - Complex Features
  - Long Transactions
  - Archiving
  - Cross-RDBMS

ArcGIS

SQL
ST_Geometry spatial type configuration

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

Configuring the Oracle extproc to access the geodatabase with SQL

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")
        )
    )
```
Demo: Configuring ST_Geometry for SQL Access

Amit Kesarwani
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.
Agenda

Administration and Connections

Administration Tools

Connections

User Permissions

Client Compatibility
Administration Tools

- Oracle and ArcGIS
- ArcSDE Command Line Tools
  - Going away at 10.3, replaced with new geoprocessing (GP) tools
- ArcGIS Desktop and GP
  - Python and Automation
Administrative Tools
Connection Architectures

“Direct Connect” – recommended and only method post 10.2.2

“Application Server” – legacy connection method, 10.2.2 last release
Connections: New Approach at ArcGIS 10.1

- A new approach to connecting to databases:
  - Connect to databases as well as Geodatabases, no SDE administrative schema required.
  - Setup database client libraries (32 bit for Desktop)
  - Use a simplified connection dialog, Direct Connect default
## 10.1 Oracle Instance Connection string

<table>
<thead>
<tr>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>server name/service name (or ID)</td>
<td><code>dbsrvr/orcl</code></td>
</tr>
<tr>
<td>IP address of server/service name (or ID)</td>
<td><code>10:10:10:10/orcl</code></td>
</tr>
<tr>
<td>server name:port/service name (or ID)</td>
<td><code>dbsrvr:60000/orcl</code></td>
</tr>
<tr>
<td>IP address of server:port/service name (or ID)</td>
<td><code>10:10:10:10:60000/orcl</code> or</td>
</tr>
<tr>
<td></td>
<td><code>[6543:e04:0:1:f587:1249:12f9:w3ud]:60000/orcl</code></td>
</tr>
<tr>
<td>URL of server</td>
<td><code>//dbsrvr:60000/orcl</code></td>
</tr>
<tr>
<td>server name only (if listener configured to point to default instance)</td>
<td></td>
</tr>
</tbody>
</table>

If instance not listening on default port number, must use connection syntax that includes port number.
User Privileges

Roles

- SDE Administrative user
- Data Owners
- Editors
- Viewers

ArcGIS Tools

Create Database User

- Input Database Connection: Database Connections\Connection to flapjack.sde
- Database User: new_user
- Database User Password (optional): ********
- Role (optional): bunch
- Tablespace Name (optional):
## Standard 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
Monitor Connections and Locks in ArcGIS

- “kill” connections
- Direct Connections and Application Server Connections
- check lock type
- introduced at 10.1
Client – Geodatabase Compatibility

• 10.x forwards and backwards compatibility
• Note: 10.2 will be last major release for:
  - ArcSDE command line tools
  - ArcSDE Application Server
  - ArcSDE C and Java SDK

<table>
<thead>
<tr>
<th>Client release</th>
<th>Enterprise, workgroup, or desktop geodatabase using a direct connection</th>
<th>Enterprise geodatabase using an ArcSDE service connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3</td>
<td>9.3 (if client has pre-9.3 geodatabase direct-connect files* installed, can connect to 9, 9.1, and 9.2)</td>
<td>9, 9.1, 9.2, 9.3</td>
</tr>
<tr>
<td>10</td>
<td>9.2, 9.3, 10, 10.1, 10.2</td>
<td>9.2, 9.3, 10, 10.1, 10.2</td>
</tr>
<tr>
<td>10.1</td>
<td>9.3, 10, 10.1, 10.2</td>
<td>9.3, 10, 10.1, 10.2</td>
</tr>
<tr>
<td>10.2</td>
<td>9.3, 10, 10.1, 10.2</td>
<td>9.3, 10, 10.1, 10.2</td>
</tr>
</tbody>
</table>
Demo: Installing the Instant Client
Amit Kesarwani
Agenda

- Backup and Upgrade
- Recovery Models
- Backup and Restore
- Upgrades

Administering your Oracle Geodatabase
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.
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
Agenda

- Requirements and Configuration
- Administration and Connections
- Backup and Upgrade
- Performance and Advanced Topics
Agenda

Performance and Advanced Topics

Performance

Monitoring and Troubleshooting

Advanced Topics

Conclusion

Administering your Oracle Geodatabase
Performance and the Platform
Services Based

- Services
- Desktops
- Editing vs Viewing/Analysis
Performance: Understand the Stack and Isolate

is the problem in the database?
Managing Performance in 11g: 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
Oracle 11g – Automatic Maintenance

Optimizer Statistics Collection – statistics collection
Segment Advisor – segment reorganization
SQL Tuning Advisor – attempts to tune high-load SQL

• Tasks Automated at 11g

Oracle Database 11g provides the ability to automatically manage maintenance tasks such as optimizer statistics collection and proactive advisor reports. These tasks are run in a predefined maintenance window and their CPU consumption is throttled to prevent them from interfering with normal user work. The default maintenance windows are 10:00 PM - 2:00 AM on weekdays, and all weekend long. These defaults can be changed using Enterprise Manager at any time.

Enable automatic maintenance tasks
**Geodatabase: Proper Maintenance = Performance**

- Well designed automated maintenance process - nightly, weekly, etc..
- Well designed and maintained Version and Replica architecture
- include Backup, ETL’s, Reporting, etc…
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
Monitor Resources

Physical and Virtual Environments

- Be careful of any of the following thresholds:
  - Processor utilization > 70%
  - Memory utilization > 80% of physical
  - Storage utilization > 80% of storage capacity
  - Average Disk Seconds / Read > 10ms
  - Average Disk Seconds / Write > 10ms
- If Cloud deployment
  - different locations may have different behavior (resources/equipment)

- Tools
  - ESRI System Monitor
  - 3rd Party Tools
  - Windows Events
Diagnostic Files

- Oracle log files, contain DBMS logged information
  - System alert log: alert_<sid>.log
  - Background process logs
SDE Intercept

- A list of all calls between the SDE client and the SDE sever.
  - If using DC, will have two files that mirror each other.

- To enable set:
  - `%SDEINTERCEPT%` to the required values
    - `set SDEINTERCEPT=cwrfT`
  - `%SDEINTERCEPTLOC%` to the path name
    - Files are named `%SDEINTERCEPTLOC%001`, `%SDEINTERCEPTLOC%002`...
Oracle SQL Trace

- Description of every SQL statement that was executed per session
  - Use in analysis of slow running queries and operations, TKProf easier to read.

- Activate by altering session
  - As DBA user: `SQL> DBMS_SYSTEM.SET_ENV(<session id>, <session serial>, 10046, 12, '')`

---

**OVERALL TOTALS FOR ALL NON-RECURSIVE STATEMENTS**

<table>
<thead>
<tr>
<th>call</th>
<th>count</th>
<th>cpu</th>
<th>elapsed</th>
<th>disk</th>
<th>query</th>
<th>current</th>
<th>rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parse</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Execute</td>
<td>16</td>
<td>0.17</td>
<td>0.19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fetch</td>
<td>189</td>
<td>2.96</td>
<td>3.53</td>
<td>0</td>
<td>1605</td>
<td>0</td>
<td>17820</td>
</tr>
<tr>
<td></td>
<td>205</td>
<td>3.14</td>
<td>3.72</td>
<td>0</td>
<td>1605</td>
<td>0</td>
<td>17820</td>
</tr>
</tbody>
</table>

Misses in library cache during parse: 0

Elapsed times include waiting on following events:

- SQL*Net message to client: 200 times, max wait 0.00, total waited 0.00
- SQL*Net message from client: 199 times, max wait 0.52, total waited 2.50
- SQL*Net more data to client: 923 times, max wait 0.00, total waited 0.09
- Direct path read: 44 times, max wait 0.05, total waited 0.15
- Log file sync: 12 times, max wait 0.00, total waited 0.00
Advanced Configuration Topics

• Some not formally supported – must test

• External Authentication – Direct Connect
  - OS Authentication
  - Advanced Security
  - Encryption
  - Must use Direct Connect

• Oracle RAC – clusters (High Availability – HA)
  - Must use Direct Connect

• Oracle DataGuard – RDBMS Replication (Failover)
  - Physical – “stand by”
  - Logical
Oracle RAC

• 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
  - Windows ST_ShapeLib.dll is dependent on dlls found in the Visual C++ Redistribution Package.
  - Installed by SDE setup program automatically, or can be installed using redistribution package

• Cursors
  - Cursors don’t failover, reconnect either must be done or takes place depending upon application and configuration.
Oracle Dataguard

• Physical – standby database – commonly used
• Logical – RDBMS replication - rare in Geodatabase configurations
  - Users can connect to “standby” database, but should be treated as “read-only”.
  - Not supported, and configuration complex due to SQL exclusion required.
Views, Spatial Views and Types

• Spatial Functions can be used in Spatial Views
  - Can provide “dynamic” feature classes on map

```sql
CREATE VIEW san_berdoo_quakes_v AS SELECT a.objectid,
a.location, b.name FROM quakes4 a, st_counties b WHERE
b.name = 'San Bernardino' AND
sde.st_intersects(a.location,b.boundary);
```

• Also Materialized Views

• May require registration with ArcSDE and Geodatabase
  - Depending upon creation method used
    - sdetable –o create_view vs. SQL
  - Depending upon intended use
    - Display in arcmap or for sql query only, Query Layer (10.x)
Thank you for attending...