Administering your Oracle Geodatabase
Travis Val and Jim McAbee
tval@esri.com
jmcabbee@esri.com
Agenda

Requirements and Configuration

Administration and Connections

Backup and Upgrade

Performance and Advanced Topics
Agenda

- Requirements and Configuration
- Supported Versions
- Setup and Configuration
- Spatial Types
## Oracle Versions and Supported OS

<table>
<thead>
<tr>
<th>Version</th>
<th>DBMS and OS</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.2.0.1</td>
<td>Oracle Linux 5 &amp; 6, Red Hat Linux AS/ES 5 &amp; 6, SUSE Linux 11, Windows Server 2008 R2, IBM AIX 6.1 &amp; 7.1, Sun Solaris 10</td>
<td>64-bit DBMS and OS only</td>
</tr>
<tr>
<td>11.1.0.7</td>
<td>Red Hat Linux AS/ES 5 &amp; 6, Windows Server 2003 &amp; 2008 R2, IBM AIX 6.1, Sun Solaris 9 &amp; 10</td>
<td>64-bit DBMS and OS only</td>
</tr>
<tr>
<td>10.2.0.3</td>
<td>Red Hat Linux AS/ES 5, Windows Server 2003, IBM AIX 6.1, Sun Solaris 9 &amp; 10</td>
<td>64-bit DBMS and OS only</td>
</tr>
</tbody>
</table>

**ArcGIS 10.2**

- 64-bit DBMS and OS only

**ArcGIS 10.1**

- 64-bit DBMS and OS only
- Exadata Oracle Linux 11gr2 (11.2.0.1) support.
- Oracle Linux 5 & 6 support began at 10.1 SP1

**ArcGIS 10**

- 32 & 64-bit DBMS and OS
Setting up Oracle: Initialization Parameters

- **Memory Parameters**
  - 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
  - UNDO_POOL enough for compress

- **Cursor Configuration**
  - OPEN_CURSORS = 2000
  - Tech Article #27024
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

The parameter values listed here are currently used.

<table>
<thead>
<tr>
<th>Name</th>
<th>Basic</th>
<th>Mode</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>cursor</td>
<td>All</td>
<td>All</td>
<td>Boolean</td>
<td>FALSE</td>
</tr>
<tr>
<td>audit_sys_operations</td>
<td></td>
<td></td>
<td>Boolean</td>
<td></td>
</tr>
<tr>
<td>audit_trail</td>
<td></td>
<td></td>
<td>Boolean</td>
<td></td>
</tr>
<tr>
<td>background_core_dump</td>
<td></td>
<td></td>
<td>Integer</td>
<td></td>
</tr>
<tr>
<td>background_dump_dest</td>
<td></td>
<td></td>
<td>String</td>
<td></td>
</tr>
<tr>
<td>cursor_bind_capture_destination</td>
<td></td>
<td></td>
<td>Memory+Disk</td>
<td></td>
</tr>
<tr>
<td>cursor_sharing</td>
<td></td>
<td></td>
<td>Exact</td>
<td></td>
</tr>
<tr>
<td>cursor_space_for_time</td>
<td></td>
<td></td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td>open_cursors</td>
<td>1</td>
<td></td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>session_cached_cursors</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>
Setting up Oracle: Packages

• Grant Execute to Public on
  - DBMS_PIPE
  - DBMS_LOCK
  - DBMS_LOB
  - DBMS.Utility
  - DBMS_SQL
  - UTL_RAW
  Default

• Grant Execute to SDE on
  - DBMS_CRYPTO

• After GDB creation or upgrade, privileges can be restricted
Oracle based Geodatabase: Enabling

Geodatabase

- Schema
- Schema
- Schema
- SDE

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 Configuration: Connections

**sde.server_config table**

- sessions and processes

```
<table>
<thead>
<tr>
<th>prop_name [PK] character varying(32)</th>
<th>char_prop_value character varying(5)</th>
<th>num_prop_value integer</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALLOWSESSIONLOGFILE</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>ATTRBUFSIZE</td>
<td></td>
<td>50000</td>
</tr>
<tr>
<td>AUTH_KEY</td>
<td>arcsdeserver, 101</td>
<td></td>
</tr>
<tr>
<td>AUTOCOMMIT</td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>BLOBMEM</td>
<td>10000000</td>
<td></td>
</tr>
<tr>
<td>CONNECTIONS</td>
<td></td>
<td>64</td>
</tr>
<tr>
<td>DEFAULTPRECISION</td>
<td></td>
<td>64</td>
</tr>
<tr>
<td>DISABLEDC</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>ERRLOGMODE</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>HOLDLOGPOOHTABLES</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>INT64TYPES</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>LARGEBLOCK</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>LAYERAUTOLOCKING</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>LOGFILEPOOLSIZE</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
```
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
Oracle Schema Geodatabase Admin
An option for multiple Oracle Geodatabases

- Geodatabase contained in specific User Schema
- SDE “master” geodatabase present – sde.instances
- Rules
  - a user own only one geodatabase
  - user is the geodatabase administrator with privileges
  - user can only own data in that geodatabase
  - users that do not own a geodatabase can only own data in the master geodatabase
Spatial Types and Functions

- Creation of Features through SQL
- Analysis 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>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
ESRI Spatial Type – ST_GEOMETRY

- 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
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
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
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")
    )
  )
```
Demo: Configuring ST_Geometry
SDO_Geometry: native Oracle spatial type

- Locator (free) 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

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

Administration and Connections

Administration Tools

Connections

User Permissions

Client Compatibility
Administration Tools

- Oracle and ArcGIS
- ArcSDE Command Line Tools (10.2 last release)
- Some things are still only possible with the cmd
  - DBTUNE maintenance
  - Sde service creation and maintenance
    (if sde application server type connection used)
Administrative Tools
Administrative Tools: ArcGIS
Connection Architectures

“Direct Connect” – recommended and future method post-10.2

“Application Server” – legacy connection method, 10.2 last release supporting

ArcSDE libraries
Oracle Client
Geodatabase

ArcSDE Libraries
giomgr
gsrvr
Database Server

ArcSDE libraries
Oracle Client
Geodatabase

ArcSDE libraries
Oracle Client
Geodatabase

1521
5151
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
  - Use a simplified connection dialog, Direct Connect default
Connecting to Oracle

10.1 and 10.2
- Server – 64 bit
- Desktop – 32 bit

Oracle client libraries need to match
### 10.1 Oracle Instance Connection string

<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>IP address of server:port/service name (or ID)</td>
<td>10:10:10:10:60000/orcl or [6543:e04:0:1:f587:1249:12f9:w3ud]:60000/orcl</td>
</tr>
<tr>
<td>URL of server</td>
<td>//dbsrvr:60000/orcl</td>
</tr>
</tbody>
</table>

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

- SDE Administrative user
- Data Owners
- Editors
- Viewers

ArcGIS Tools
## 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</td>
<td>CREATE SEQUENCE, CREATE TRIGGER, CREATE VIEW, CREATE TABLE</td>
</tr>
<tr>
<td>Geodatabase administrator</td>
<td>CREATE SESSION</td>
<td>CREATE SEQUENCE, CREATE TABLE, CREATE TRIGGER, CREATE PROCEDURE</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
Agenda

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

- Backup and Upgrade
- Recovery Models
- Backup and Restore
- Upgrades
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_UTILTY.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
  - Python script
- Backup, but don’t re-use, compare
  - dbinit.sde
  - dbtune.sde
- OS – Oracle – GDB – test between if possible
- Existing GDB check automatic
- Clean DBMS_PIPE - Values in the database pipe can cause connection problems
Upgrading Schema based Geodatabase

- Must upgrade master first and not simultaneously

- Must make a backup of the entire database; creating a backup of only a user's schema does not include the user-defined types and functions

- Stopping the ArcSDE service on the master geodatabase disables service connections to user-schema geodatabases
Agenda

Performance and Advanced Topics

Performance

Monitoring and Troubleshooting

Advanced Topics

Conclusion
Performance: Understand the Stack and Isolate

is the problem in the database?

Clients (Desktop, Browser, Devices)

Web Server

Network

Applications

Application Server(s) (ArcGIS)

Network

Geodatabase

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)
Measuring and Monitoring Memory
Diagnostic Files

• Log files are ArcSDE output about what SDE is doing
• Useful when encountering a problem such as
  - Service will not start, log file will tell you why
• ArcSDE logs stored in
  • \appdata\local\temp of user with direct connect
  • SDEHOME\etc with older application server configuration
    - giomgr_<service>.log – Client connection info
    - sde_<service>.log – Application Server error messages
    - sdedc_Oracl.egl – Direct Connect error messages
• 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
  - Very useful in analysis of slow running queries and operations, TKProf results much more readable

- Activate by altering session
  - As DBA user, tracing a different session:
    ```sql
    SQL> DBMS_SYSYEM.SET_ENV(<session id>, <session serial>, 10046, 12, ''
    ```
Oracle Trace Output – using tkprof

The output contains SQL execution paths, row counts and wait events

OVERALL TOTALS FOR ALL NON-RECURSIVE STATEMENTS

call       count    cpu   elapsed    disk    query    current    rows
       ------- ------  -------- ---------- ----------  ----------  -------
Parse     0        0.00    0.00       0        0         0         0
Execute   16       0.17    0.19       0        0         0         0
Fetch     189      2.96    3.53       0       1605       0     17820

205       3.14    3.72       0       1605       0     17820

Misses in library cache during parse: 0

Elapsed times include waiting on following events:

<table>
<thead>
<tr>
<th>Event waited on</th>
<th>Times Waited</th>
<th>Max. Wait</th>
<th>Total Waited</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL*Net message to client</td>
<td>200</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>SQL*Net message from client</td>
<td>199</td>
<td>0.52</td>
<td>2.50</td>
</tr>
<tr>
<td>SQL*Net more data to client</td>
<td>923</td>
<td>0.00</td>
<td>0.09</td>
</tr>
<tr>
<td>direct path read</td>
<td>44</td>
<td>0.05</td>
<td>0.15</td>
</tr>
<tr>
<td>log file sync</td>
<td>12</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
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

- Use Direct Connect architecture
- Extproc configuration for ST_Geometry spatial type
  - 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...

Please fill out the session evaluation

**ID: 1349**

**Online** – www.esri.com/ucsessionsurveys

**Paper** – pick up and put in drop box
Thank you for attending...

tval@esri.com
jmccabe@esri.com