10g New Features for DBAs

September 21, 2004
NYOUG General Meeting
New York

Dave Anderson
Agenda

- A brief introduction to:
  - Flashback Enhancements
  - Auto Storage Management
  - Job Scheduler
  - RMAN Enhancements
  - Performance & Tuning Enhancements
Flashback Enhancements
Flashback Evolution

- 9i provided
  - Session-level flashback
    - DBMS_FLASHBACK
  - Statement (and sub-statement) flashback
    - SQL “AS OF” clause

```sql
SQL> select a.lastname, a.total_purchase, b.total_purchase
2  from sales a, sales AS OF timestamp(sysdate - 1) b
3  where a.cust_no = b.cust_no
4  and a.total_purchase != nvl(b.total_purchase, 0);
```

<table>
<thead>
<tr>
<th>LASTNAME</th>
<th>TOTAL_PURCHASE</th>
<th>TOTAL_PURCHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANDERSON</td>
<td>55000</td>
<td></td>
</tr>
<tr>
<td>DASWANI</td>
<td>55000</td>
<td></td>
</tr>
</tbody>
</table>

Amount yesterday

Amount today

Can compare table to a previous version of itself
10g Enhancements

- Flashback Version Query
  - "VERSIONS BETWEEN" clause
- Flashback Transaction Query
  - FLASHBACK_TRANSACTION_QUERY view
- Flashback Table
  - Recover table to previous point-in-time
  - Recover from DROP
- Flashback Database
  - Recover database to previous PIT
Flashback Setup

- Flashback query and flashback table (sometimes) require **AUM and sufficient UNDO**

```sql
LINUX> show parameter undo_

<table>
<thead>
<tr>
<th>NAME</th>
<th>TYPE</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>undo_management</td>
<td>string</td>
<td>AUTO</td>
</tr>
<tr>
<td>undo_retention</td>
<td>integer</td>
<td>172800</td>
</tr>
<tr>
<td>undo_tablespace</td>
<td>string</td>
<td>UNDOTBS1</td>
</tr>
</tbody>
</table>

1. select file_name, bytes
2. from dba_data_files
3. where tablespace_name = 'UNDOTBS1'

<table>
<thead>
<tr>
<th>FILE_NAME</th>
<th>BYTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.1</td>
<td>209715200</td>
</tr>
<tr>
<td>+ASM_DISK_GROUP1/orcl/datafile/undotbs1.295.17</td>
<td>104857600</td>
</tr>
</tbody>
</table>
```

48 hours
Flashback Version Query…

- Show all “versions” of data between two
  - SCN’s
  - Timestamps
- “Version” is transaction-based
DAVE@LINUX> select c2, versions_starttime, versions_endtime,  
2       versions_startscn, versions_endscn,  
3       versions_operation, versions_xid  
4  from system.test  
5      versions between timestamp  
6          to_timestamp('11-SEP-04 12.02.00.000000000 PM',  
7             'dd-mon-yy hh.mi.ss.ff PM')  
8          and systimestamp  
9  where c1 = '1'  
10  order by versions_startscn nulls first;

<table>
<thead>
<tr>
<th>C2</th>
<th>VERSIONS_STARTTIME</th>
<th>VERSIONS_ENDTIME</th>
<th>VERSIONS_STARTSCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
<td>11-SEP-04 12.01.55 PM</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>11-SEP-04 12.01.55 PM</td>
<td>11-SEP-04 12.01.55 PM</td>
<td>988714</td>
</tr>
<tr>
<td>c</td>
<td>11-SEP-04 12.01.55 PM</td>
<td>11-SEP-04 12.02.04 PM</td>
<td>988716</td>
</tr>
<tr>
<td>d</td>
<td>11-SEP-04 12.02.04 PM</td>
<td>11-SEP-04 12.02.17 PM</td>
<td>988719</td>
</tr>
<tr>
<td>x</td>
<td>11-SEP-04 12.02.17 PM</td>
<td></td>
<td>988730</td>
</tr>
</tbody>
</table>

New pseudocolumns

NULL in ENDTIME...this is the current value
Users need privileges to flashback

LINUX> grant flashback, select on system.test to dave;
Grant succeeded.
Flashback_Transaction_Query

- Mine (audit) undo records for details on changes
  - Easier than log miner utility
- Get XID from flashback version query

LINUX> exec print_table('select logon_user, undo_sql -
> from flashback_transaction_query -
> where xid = ''0700010059020000'' ')

LOGON_USER : SYSTEM
UNDO_SQL : delete from "SYSTEM"."TEST"
  where ROWID = 'AAALquAABAAAAIiAAA'

LINUX> grant select any transaction to dave;
Grant succeeded.

User needs this privilege
Get XID from flashback version query
Flashback Table...

- Turn back hands of time for one or more tables
- Recover from DROP TABLE
  - Uses “recycle bin”
- Recover from application or user changes
  - Uses UNDO
- Implemented with FLASHBACK TABLE statement
...Flashback Table

- Prepare
  - Enable row movement on table
  - Grant privileges to desired user(s)

```
SYSTEM@LINUX> alter table test enable row movement;
Table altered.

SYSTEM@LINUX> grant flashback on test to dave;
Grant succeeded.

SYSTEM@LINUX> grant alter, select, update, delete, insert on system.test to dave;
Grant succeeded.
```
Flashback Table: Undo Changes

DAVE@LINUX> select dbms_flashback.get_system_change_number from dual;
        X
---------
    1057181

DAVE@LINUX> flashback table system.test to timestamp 2 systimestamp - interval '30' minute;

DAVE@LINUX> select dbms_flashback.get_system_change_number from dual;
        X
---------
    1057181

DAVE@LINUX> flashback table system.test to scn 1057181;
Flashback complete.

Can undo the flashback if you know SCN

DAVE@LINUX> flashback table system.test to scn 1057181;
Flashback complete.
Flashback Table: Recover from DROP

- Dropped tables and dependent objects aren’t really dropped
- Renamed
  - “BINuniquestring”
- This is the “recycle bin” concept
- Objects actually dropped when
  - Space needed
    - Could be right away, might be there “forever”
  - Tablespace needed
  - Recycle bin purged
  - PURGE clause used on DROP
Flashback Table: Recover from DROP

- Recover from DROP TABLE or unwanted application changes

SQL> drop table big;
Table dropped.

SQL> show recyclebin
ORIGINAL NAME    RECYCLEBIN NAME
---------------- ------------------------------
BIG              BIN$Kq3scQsDQP+jkI0atdsqqQ==$0

SQL> drop table big;
Table dropped.

SQL> show recyclebin
ORIGINAL NAME    RECYCLEBIN NAME
---------------- ------------------------------
BIG              BIN$Kq3scQsDQP+jkI0atdsqqQ==$0

OBJECT TYPE  DROP TIME
------------ -------------------
TABLE        2004-08-19:11:40:00

SQL> flashback table big to before drop;
Flashback complete.

Easy and fast to recover table

Table remains in segment unless PURGE used

Table is recorded in “recycle bin”
Repeat Un-Drop

```
SQL> show recyclebin
+-----------------+-------------------------------+---------------+-----------------------+
| ORIGINAL NAME   | RECYCLEBIN NAME               | OBJECT TYPE   | DROP TIME             |
|-----------------+-------------------------------+---------------+-----------------------+
| T               | BIN$KbsjpLROT6+eGOGqifipQ==$0 | TABLE         | 2004-09-19:14:59:30   |
| T               | BIN$y0AR2dYXSnC0bRn+vJTF0Q==$0| TABLE         | 2004-08-19:16:52:54   |

SQL> flashback table t to before drop;
Flashback complete.

SQL> show recyclebin
+-----------------+-------------------------------+---------------+-----------------------+
| ORIGINAL NAME   | RECYCLEBIN NAME               | OBJECT TYPE   | DROP TIME             |
|-----------------+-------------------------------+---------------+-----------------------+
| T               | BIN$y0AR2dYXSnC0bRn+vJTF0Q==$0| TABLE         | 2004-08-19:16:52:54   |

SQL> rename t to t_old;
Table renamed.

SQL> flashback table t to before drop;
Flashback complete.

SQL> show recyclebin
SQL>```
### Purging Recycle Bin

```sql
SQL> show recyclebin
ORIGINAL NAME   RECYCLEBIN NAME                OBJECT TYPE  DROP TIME
---------------- ------------------------------ ------------ -------------------
T2               BIN$cfmTndAnQk+junRG6hCngg==$0 TABLE        2004-09-19:14:59:28
T_AUDIT          BIN$Fx+nQHXcR4qgr4fSc18QiQ==$0 TABLE        2004-08-23:15:52:29
T_AUDIT          BIN$mPxGfYd8QJ+sLvSNPLszZg==$0 TABLE        2004-08-23:15:51:13
T_AUDIT          BIN$7sKuyR6YR7KM4Bc7mzewiQ==$0 TABLE        2004-08-23:15:19:19
T_AUDIT          BIN$ZD1sowFXTt6T7uFsmDt4aw==$0 TABLE        2004-08-23:13:50:33
T_AUDIT          BIN$ZoUtaPCQcC0eEhgZd+HRw==$0 TABLE        2004-08-23:13:49:26
T_AUDIT          BIN$Em072EijQIilk8I5QhHFrA==$0 TABLE        2004-08-23:13:48:08
T_AUDIT          BIN$nuPfG+vCT8OsZDi41J0jdA==$0 TABLE        2004-08-23:13:05:05

SQL> purge recyclebin;
Recyclebin purged.

SQL> show recyclebin
SQL>
```
Flash Recovery Area…

- Optional storage area for backup-related files
  - Online and archive logs
  - RMAN backups
    - Default location for RMAN backups if configured
  - Flashback logs
    - Required for FLASHBACK DATABASE
    - "Automates management of backup-related files"
      - Convenient directory structure
      - Auto-delete obsolete files when space needed
  - Keep on separate disk from datafiles

Next topic is FB Database…
Flash Recovery Area...

- **Set space limit**
  - Maximum space dedicated to flashback area
- **Set retention limit**
  - How far back can we flashback database?

<table>
<thead>
<tr>
<th>NAME</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>db_recovery_file_dest</td>
<td>/mnt/mickeymantle</td>
</tr>
<tr>
<td>db_recovery_file_dest_size</td>
<td>10G</td>
</tr>
<tr>
<td>db_flashback_retention_target</td>
<td>1440</td>
</tr>
<tr>
<td>log_archive_dest_1</td>
<td>LOCATION=USE_DB_RECOVERY_FILE_DEST</td>
</tr>
</tbody>
</table>

- Write archive logs to flash recovery area
- Limit size
- How long to keep flash logs
…Flash Recovery Area…

- New V$ view

```sql
SQL> exec print_table('select * from v$recovery_file_dest')
NAME                          : /mnt/mickeymantle/
SPACE_LIMIT                   : 10737418240
SPACE_USED                    :  2485816832
SPACE_RECLAIMABLE             :    19995648
NUMBER_OF_FILES               :          35
```

How much space can be made available through delete of “obsolete, redundant or low priority files”
...Flash Recovery Area

Choose the recovery options for the database:

- Specify Flash Recovery Area
  - This is used as the default for all backup and recovery operations, and is also required for automatic backup using Enterprise Manager. Oracle recommends that the database files and recovery files be located on physically different disks for data protection and performance.

  - Flash Recovery Area: /mnt/mickey/martis
  - Flash Recovery Area Size: 2048 MBytes

- Enable Archiving
  - Edit Archive Mode Parameters...

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Flashback Database...

- Alternative to point-in-time recovery
  - Very easy
  - Can flashback many times
    - Until you OPEN RESETLOGS
- Use *flashback logs* to recover database
  - Contain changed blocks
  - Ongoing creation of new logs to capture changes
  - Written to “Flash Recovery Area”
  - Transactions dictate frequency / size of logs
- Open questions
  - Exactly what initiates log write? What’s threshold?
  - Automatic deletion of obsolete logs
…Flashback Database

- Overhead
  - Initial tests show measurable increase
  - Stay tuned…
- Performance versus point-in-time recovery
  - Often faster
  - Reapply changed blocks versus restore then recover
Flashback Database: Setup

- Configure flash recovery area
  - Destination, size limit, retention
- Configure database

SQL> alter database flashback on;
Database altered.

SQL> select flashback_on from v$database;
FLA
---
YES

Starts recovery writer background process (RVWR)
Flashback Database: Example

SQL> startup mount

SQL> alter database datafile 2> '+ASM_DISK_GROUP1/orcl/datafile/users.268.1' offline;

Database altered.

SQL> flashback database to scn 1427369;

Flashback complete.

SQL> alter database open read only;

Database altered.

SQL> alter database datafile
2> '+ASM_DISK_GROUP1/orcl/datafile/users.268.1' offline;

Database altered.

SQL> flashback database to scn 1427369;

Flashback complete.

SQL> alter database open read only;

Database altered.

SQL> alter database open resetlogs;

Database altered.

SQL> alter database open resetlogs;

Database altered.

Resetlogs deletes old FB logs

Optional step - offline files are not flashed back

Flashback to SCN or timestamp. Need SYSDBA privilege.

Can open READ ONLY to check things out

Can then re-mount, flashback to different scn or time

NOW DO FULL BACKUP!
Flashback Summary

- Flashback Query
  - Session or sub-statement level
  - Query data at a previous point-in-time
- Flashback Version Query
  - Show changes made by transactions
  - Details about transaction
- Flashback Transaction Query
  - Access UNDO records, including undo-SQL
- Flashback Table
  - “Reset” table to previous point-in-time
  - Recover from dropped table
- Flashback Database
  - Point-in-time recovery for entire database
  - Must configure database for this…
Introducing ASM

- Built-in file system and volume manager
  - “Vertical integration of both the file system and the volume manager”
  - Oracle Corp
- Automated S.A.M.E.
  - Striping to balance I/O load
  - Even with database open
  - 2 or 3-way mirroring
- Major extension to Oracle Managed Files (9i)
- Can hold all database-related files
  - Not Oracle executables
- Supports Real Application Clusters
The ASM Instance…

- A completely separate instance
  - See parameter INSTANCE_TYPE=ASM
- Each physical Oracle server has one ASM instance
  - Can be used by many database instances
  - Failure of ASM instance causes failure of dependents
- Starts background process to manage ASM disk metadata
  - Requires approximately 100MB
- ASM instance has no database
  - No datafiles, control file, log files
  - No need to backup ASM
The ASM Instance

- DBCA will either
  - Create new ASM instance
  - Configure diskgroups
  - Allow use of existing ASM instance and diskgroups
  - Can configure new diskgroups
...The ASM Instance

- Must start ASM instance before dependent database instances
- Stop ASM instance last
  - Dependent database instances will crash if ASM instance shut down first
- Handles IO errors
  - Remove disk if suffers write errors
  - Read from secondary disk for read errors
Starting “+ASM” Instance

- Start ASM first
  - Mounts all diskgroups in ASM_DISKGROUPS parameter
- Shutdown ASM last

```bash
[oracle@springsteen oracle]$ ORACLE_SID=+ASM
[oracle@springsteen oracle]$ sqlplus / as sysdba
.
SQL> startup
ASM instance started

Total System Global Area  100663296 bytes
Fixed Size                   777616 bytes
Variable Size              99885680 bytes
Database Buffers                  0 bytes
Redo Buffers                      0 bytes
ASM diskgroups mounted
SQL>
```

Default ASM instance name

Must (always) connect as SYSDBA

Mounts disks; no database to open!
ASM Disks

- ASM disks must be discovered
  - Linux
    - Give raw devices to ASM
    - Or install “ASMLIB”
  - Windows
    - Assign unformatted logical partitions to ASM?
- Parameter ASM_DISKSTRING to discover disks
  - Can limit to specific disks
  - Query V$ASM_DISK to see available disks
ASM Diskgroups…

- Create diskgroups from ASM disks
  - Like a volume or storage group
- Used by one or more database instances
- Striping for balanced IO load across disks
  - Files extents “distributed equally across all … disks in the diskgroup”*
...ASM Diskgroups

- Mirroring
  - External
    - Use EMC or other storage product
  - Normal
    - 2-way
  - High
    - 3-way

- Failgroups provide ASM (internal) mirroring
Creating Diskgroup

```sql
+ASM> create diskgroup group1 normal redundancy
  2  failgroup fgroup1 disk '/dev/raw/raw1', '/dev/raw/raw2'
  3  failgroup fgroup2 disk '/dev/raw/raw3', '/dev/raw/raw4';

Diskgroup created.

SQL> select * from v$asm_diskgroup;

GROUP_NUMBER NAME         SECTOR_SIZE BLOCK_SIZE
------------ ------------ ----------- ----------
     1  GROUP1               512       4096

ALLOCATION_UNIT_SIZE STATE     TYPE     TOTAL_MB      FREE_MB
----------------------- ------- ------ -------- -------
     1048576 MOUNTED   NORMAL     136848       136744

+ASM> select g.name as group_name, d.name as disk_name, d.path, d.failgro
  2  from v$asm_diskgroup g, v$asm_disk d
  3  where g.group_number = d.group_number

GROUP_NAME DISK_NAME        PATH             FAILGROUP
--------- ---------------- ----------------
GROUP1     GROUP1_0003      /dev/raw/raw4    FGROUP2
GROUP1     GROUP1_0002      /dev/raw/raw3    FGROUP2
GROUP1     GROUP1_0001      /dev/raw/raw2    FGROUP1
GROUP1     GROUP1_0000      /dev/raw/raw1    FGROUP1
```
Altering Diskgroup

- Easily add or remove disks while database open
- Automatic rebalancing starts

```
+ASM> alter diskgroup group1 drop disk GROUP1_0002;
Diskgroup altered.

+ASM> select * from v$asm_operation
2  /
GROUP_NUMBER OPERA  STAT  POWER  ACTUAL  SO FAR  EST_WORK  EST_RATE
--------- ------- ----- ------ ------ ------ ------- -------
1 REBAL  RUN    1      1     181    1275    338

EST_MINUTES
---------     3
```
Database Instance

- Databases can mix
  - ASM files, OS files, raw
- Can setup OMF DB_CREATE_* parameters
- ASM files are not visible to OS
- Backup with RMAN

SQL> select name from v$datafile;
NAME
-----------------------------
+GROUP1/orcl/datafile/sysaux.256.3
+GROUP1/orcl/datafile/system.258.3
+GROUP1/orcl/datafile/undotbs1.265.3
+GROUP1/orcl/datafile/users.265.3

SQL> select member from vlogfile;
MEMBER
----------------------
+GROUP1/orcl/onlinelog/group_3.264.3
+GROUP1/orcl/onlinelog/group_2.266.3
+GROUP1/orcl/onlinelog/group_1.267.3

Can create ASM aliases for ASM FQFN’s
Some ASM Benefits

- Easy S.A.M.E. implementation
- Raw disk IO performance
- Easy to add and remove disks
- Oracle SQL-like commands to manage
  - Same commands across all platforms
ASM Summary

- Built-in file system and volume manager
- Provides automated S.A.M.E.
- Will it - in some environments - phase out 3rd party products?
  - You’ll be the judge
- Certainly attractive to small shops at least

Resources
- Must read Oracle White Paper:
  - Oracle Database10g Automatic Storage Management Technical Best Practices by Nitin Vengurlekar
- Oracle docs
- Metalink notes
Job Scheduler
Job Scheduler - Concepts

- Replacement for DBMS_JOB
  - More capabilities
  - Can still use DBMS_JOB
    - Migrate over time
    - Uses same coordinator process
- Implemented via DBMS_SCHEDULER package
- DBCA automatically creates two jobs
  - Scheduler log purge
  - Daily DBMS_STATS
Capability Overview…

- Schedule jobs to run one or more times
  - PL/SQL
  - OS scripts
- Powerful and flexible scheduling capability
- Pass parameters at run time
- Control resource usage
  - Establish job “classes”
    - Group jobs with same characteristics into a class
  - Prioritize with resource plans (see Resource Manager)
  - Set “windows”
    - Different resource plans at different times
...Capability Overview

- Define “programs”
  - Pre-defined reusable OS executable
- Monitor job status and progress
  - Job details recorded in job log
- Control
  - Amount of logging by job class
  - Lifespan of entries

```sql
SQL> exec dbms_scheduler.set_scheduler_attribute -> ('log_history', '45')
PL/SQL procedure successfully completed.
```

- Define number of failures that dictate “broken” job
- RAC supported
- Export scheduler objects with Data Pump

Keep log data for 45 days
Create Schedule & Job

```
begin
  dbms_scheduler.create_schedule (
    schedule_name  => 'backup_schedule',
    start_date     => SYSTIMESTAMP,
    repeat_interval=> 'FREQ=DAILY; BYHOUR=01',
    comments       => 'Schedule for daily backups');
end;
/
```

```
begin
  dbms_scheduler.create_job (
    job_name => 'system.daily_backup',
    schedule_name => 'dave.backup_schedule',
    job_type => 'executable',
    job_action => '/home/oracle/full_backup.sh',
    enabled => true,
    comments => 'Daily full backup');
end;
/
```

- Runs with privs of owner.
- Run daily at 1 AM
- Run OS command
- Specify path
OS Scripts

- Fully qualify paths
- Set permissions
- Set environment variables

```
#!/bin/sh
exec >/tmp/log.txt 2>&1
export ORACLE_HOME=/u01/app/oracle/product/10.1.0/db_2
export PATH=$ORACLE_HOME/bin:$PATH
rman target sys/dave@orcl cmdfile /home/oracle/full_backup.rman
```

```
backup database plus archivelog tag='daily full backup';
exit;
```
## Stored Jobs

```sql
LINUX> exec print_table('select owner, job_name, program_owner, program_name, -
> schedule_owner, schedule_name, start_date, repeat_interval, -
> last_start_date, next_run_date, comments -
> from dba_scheduler_jobs')

<table>
<thead>
<tr>
<th>OWNER</th>
<th>SYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB_NAME</td>
<td>PURGE_LOG</td>
</tr>
<tr>
<td>PROGRAM_OWNER</td>
<td>SYS</td>
</tr>
<tr>
<td>PROGRAM_NAME</td>
<td>PURGE_LOG_PROG</td>
</tr>
<tr>
<td>SCHEDULE_OWNER</td>
<td>SYS</td>
</tr>
<tr>
<td>SCHEDULE_NAME</td>
<td>DAILY_PURGE_SCHEDULE</td>
</tr>
<tr>
<td>START_DATE</td>
<td>02-SEP-04 03.00.00.000000 AM -04:00</td>
</tr>
<tr>
<td>REPEAT_INTERVAL</td>
<td></td>
</tr>
<tr>
<td>LAST_START_DATE</td>
<td>07-SEP-04 03.00.00.437528 AM -04:00</td>
</tr>
<tr>
<td>NEXT_RUN_DATE</td>
<td>08-SEP-04 03.00.00.000000 AM -04:00</td>
</tr>
<tr>
<td>COMMENTS</td>
<td>purge log job</td>
</tr>
</tbody>
</table>

-----------------

<table>
<thead>
<tr>
<th>OWNER</th>
<th>SYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB_NAME</td>
<td>GATHER_STATS_JOB</td>
</tr>
<tr>
<td>PROGRAM_OWNER</td>
<td>SYS</td>
</tr>
<tr>
<td>PROGRAM_NAME</td>
<td>GATHER_STATS_PROG</td>
</tr>
<tr>
<td>SCHEDULE_OWNER</td>
<td>SYS</td>
</tr>
<tr>
<td>SCHEDULE_NAME</td>
<td>MAINTENANCE_WINDOW_GROUP</td>
</tr>
</tbody>
</table>

```
Stored Schedules

SQL> exec print_table('select * from dba_scheduler_schedules')
OWNER                         : SYS
SCHEDULE_NAME                 : DAILY_PURGE_SCHEDULE
START_DATE                    :
REPEAT_INTERVAL               : freq=daily;byhour=3;byminute=0;bysecond
END_DATE                      :
COMMENTS                      :
-----------------------------
OWNER                         : DAVE
SCHEDULE_NAME                 : BACKUP_SCHEDULE
START_DATE                    : 06-SEP-04 02.38.31.174000 PM -04:00
REPEAT_INTERVAL               : FREQ=DAILY; BYHOUR=01
END_DATE                      :
COMMENTS                      :
: Schedule for daily backups
Other Dictionary Views

- **DBA_SCHEDULER_RUNNING_JOBS**
  - Information on active jobs

- **DBA_SCHEDULER_JOB_LOG**
  - One row for each job recorded in log

- **DBA_SCHEDULER_JOB_RUN_DETAILS**
  - Historical data on jobs
### Miscellaneous

#### Drop jobs

SQL> `exec dbms_scheduler.drop_job('daily_backup');`

PL/SQL procedure successfully completed.

#### Run job now

SQL> `exec dbms_scheduler.run_job('daily_backup');`

PL/SQL procedure successfully completed.

SQL> `exec dbms_scheduler.run_job(job_name=>'gather_stats_job', use_current_session=>false)`

PL/SQL procedure successfully completed.

- Need to own job or have ALTER JOB privilege
- Runs in another session
- Need MANAGE SCHEDULER system privilege
Privileges

- SCHEDULER_ADMIN
  - All powerful
- MANAGE SCHEDULER
  - Create, alter and drop windows, classes, window groups, purge logs
- CREATE JOB, CREATE ANY JOB
  - Create jobs, schedules and programs in schema
- EXECUTE ANY PROGRAM
  - Execute any program
- EXECUTE ANY CLASS
  - Run your jobs in any class
Scheduler Summary

- Better job scheduler than DBMS_JOB
- Integrated with Resource Manager
RMAN Enhancements
Compressed Backups

- “Real” compressed backupset pieces

```
RMAN> backup as compressed backupset full database plus archivelog;
```

Starting backup at 08-SEP-04
current log archived

- If using ASM, get piece size from ASM instance

```
+ASM> select a.name, f.blocks, f.bytes
2 from v$asm_alias a, v$asm_file f
3 where a.file_number=f.file_number
4 and type = 'BACKUPSET'
5* order by f.type, a.name
+ASM> /
```

<table>
<thead>
<tr>
<th>NAME</th>
<th>BLOCKS</th>
<th>BYTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>annnf0_TAG20040908T162645_0.284.5</td>
<td>12115</td>
<td>6202880</td>
</tr>
<tr>
<td>nnndf0_TAG20040908T161717_0.343.13</td>
<td>136003</td>
<td>557068288</td>
</tr>
</tbody>
</table>

Savings of 123888 blocks!

Tiny database; your results will vary…
Change Tracking...

- Change tracking eliminates need to read entire file during incremental backup

RMAN> sql 'alter database enable block change tracking';

sql statement: alter database enable block change tracking

RMAN> backup incremental level 0 database;

Starting backup at 08-SEP-04
class ORA_DISK_1: backup set complete, elapsed time: 00:02:45

-- later, after normal database use... 

RMAN> backup incremental level 3 database;

Starting backup at 08-SEP-04
class ORA_DISK_1: backup set complete, elapsed time: 00:00:03

Level 0 duration
Level 3 duration

Level 3 duration w/o change tracking
  time: 00:00:46
...Change Tracking

- Block change recorded in a file

```
LINUX> select * from v$block_change_tracking;
STATUS   FILENAME                                             BYTES
-------- ----------------------------------------------- ----------
ENABLED  +ASM_DISK_GROUP1/orcl/changetracking/ctf.343.9    11599872
```

- File size estimate 1/30,000 of db size

- Caution
  - Oracle doc mentions performance hit
  - Nothing specific
  - Must Test
Incrementally Updated Backups…

- Apply (merge) incremental backups into image copies
- Reduce recovery time
  - At most 24 hours of redo to apply if run daily
- Reduce number of times image copies are taken
  - Optimally, just once
Incrementally Updated Backups

Run this script daily

Apply any available level 1 incrementals to the image copy with the tag “ic1”

Create a level 1 incremental to be used to merge into image copy

Also can add:
“as compressed backupset”
“plus archivelog [delete input]”

RMAN> run {
  2> recover copy of database with tag 'ic1';
  3> backup
  4>    incremental level 1 tag 'level_1_for_image_copy_update'
  5>    for recover of copy with tag 'ic1'
  6>    database;
  7>
Starting recover at 09-SEP-04
DURATION Parameter

- Control backup rate
- More flexible and intuitive than RATE parameter

```
RMAN> backup duration 0:30 minimize load tablespace users;
Starting backup at 03-AUG-04
```

Optional:
“minimize load” says “take the entire 30 minutes”

Maximum time allotted is 30 minutes
More Enhancements...

- Archive log deletion policy
- Default backup can be configured to create
  - Normal backupset
  - Compressed backupset
  - Image copy
- Default backup location is flash recovery area (if configured)
- RMAN catalog tablespace created in SYSAUX
- RESTORE . . . PREVIEW [SUMMARY]
  - Identify the backups that would be used
- Simplified recovery through incarnations
…More Enhancements

- Restore failover
  - If error reading backup, RMAN keeps trying different backup copies until all possible exhausted
- Channel failover
- COPY command deprecated
  - BACKUP can create image copies
- CATALOG command to catalog user-made copies of backups
- More…
10g Performance and Tuning Features
What’s New?

- Automatic SGA (memory) Management
- Automatic Workload Repository
- Automatic Database Diagnostic Monitor
- Automatic Statistics Collection
- New Advisors
  - SQL Tuning Advisor
- SQL Profiles
- PL/SQL Enhancements
  - Optimizing compiler
- Data Pump Utility
- etcetera
Automatic SGA Management...

- When enabled, database controls size of:
  - Shared pool, Buffer cache, Large pool, Java pool
- Enable with SGA_TARGET
  - Set equal to memory you want dedicated to SGA
    - Must be <= SGA_MAX_SIZE
    - Dynamic parameter
  - Set = 0 to disable
  - Also set STATISTICS_LEVEL to TYPICAL
- Size of areas can dynamically change as:
  - Workload changes
  - Change made to SGA_TARGET or other SGA parameters

This feature also called “Auto Memory Mgmt” or “AMM”
...Automatic SGA Management

- Optionally set area *minimum* sizes with:
  - DB_CACHE_SIZE
  - SHARED_POOL_SIZE
  - LARGE_POOL_SIZE
  - JAVA_POOL_SIZE
- Must still manually configure:
  - KEEP, RECYCLE, Non-Standard Blocksize caches
  - Log buffer
  - Streams pool (new with 10g)
    - See STREAMS_POOL_SIZE parameter
  - *These areas are taken from SGA_TARGET*

“double underscore” versions created to restart DB with most recent value.* Create PFILE from SPFILE to see…__shared_pool_size
Auto SGA Demo...

```sql
SQL> select name, value
2  from v$parameter
3  where name like 'sga_%';

NAME                 VALUE
--------------------  -----------
sga_max_size 209715200
sga_target 163577856

SQL> select sum(current_size)
2  from v$sga_dynamic_components;

SUM(CURRENT_SIZE)
-----------------  
1635778560

SQL> select component, current_size
2  from v$sga_dynamic_components;

COMPONENT                 CURRENT_SIZE
------------------------- ------------
shared pool                   50331648
large pool                     4194304
java pool                      4194304
streams pool                         0
DEFAULT buffer cache         104857600
```
Auto SGA Demo

SQL> select * from v$sga_dynamic_free_memory;

CURRENT_SIZE
-----------
  41943040

SQL> alter system set sga_target=200m;
System altered.

SQL> select sum(current_size)  
  2  from v$sga_dynamic_components;

SUM(CURRENT_SIZE)  
--------------------
    205520896

SQL> select * from v$sga_dynamic_free_memory;

CURRENT_SIZE
-----------
  41943040

SQL> alter system set sga_target=200m;
System altered.

SQL> select sum(current_size)  
  2  from v$sga_dynamic_components;

SUM(CURRENT_SIZE)  
--------------------
    205520896

SQL> select component, current_size  
  2  from v$sga_dynamic_components;

COMPONENT                 CURRENT_SIZE
------------------------- ------------
shared pool                   50331648
large pool                     4194304
java pool                      4194304
streams pool                         0
DEFAULT buffer cache         146800640

Buffer cache given more memory
AWR...

- Automatic Workload Repository
- Repository of performance statistics
  - Don’t have to replay workload to diagnose problem!
- “AWR forms the foundation for all self-management functionality of Oracle Database” Concepts manual
  - Feeds the “auto” stuff
- Replaces STATSPACK?
  - You’ll be the judge
- Used by:
  - The “Advisors”
  - ADDM
  - DBA
  - Auto SGA?

SYSDBA> select advisor_name from dba_advisor_definitions;

ADVISOR_NAME
--------------------
ADDM
SQL Access Advisor
Undo Advisor
SQL Tuning Advisor
Segment Advisor
SQL Workload Manager
Tune MView

We will discuss Advisors later…
SGA / shared pool contains statistics
- Snapshot every 60 minutes
- 1 – 2 Mb per CPU
- Increase shared pool 15% – 20% over 9i size*
- Query V$SYSSTAT, V$SEGMENT_STATISTICS, etcetera

Written to SYSAUX tablespace
- Default write interval every 30 minutes
- Default duration saved - 7 days
  - Maybe increase to 30 days?
- Query DBA_HIST_* and WRM$_* tables
  - DBA_HIST_ACTIVE_SESS_HISTORY
  - DBA_HIST_WAITSTAT

See new background processes MMON and MMML that handle these tasks
Controlling AWR

- Control with DBMS_WORKLOAD_REPOSITORY package

```sql
SYSDBA> exec dbms_workload_repository.modify_snapshot_settings( - > retention=>43200, - > interval=>30)
PL/SQL procedure successfully completed.
SYSDBA> select * from dba_hist_wr_control
2  /
                  DBID SNAP_INTERVAL     RETENTION
                ---------- ----------------- -----------------
3652163603 +00000 00:30:00.0 +00030 00:00:00.0
```

Retention = 43200 minutes = 30 days

Can set interval to 0 (1 year), effectively turning off snapshots.
AWR Reporting

- Use scripts or Enterprise Manager
- AWRRPT.SQL creates text or HTML report
- “statspack-like” report
  - For specified time period

```
SQL> @%ORACLE_HOME%\rdbms\admin\awrrpt

Specify the Begin and End Snapshot Ids
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Enter value for begin_snap: 85
Begin Snapshot Id specified: 85

Enter value for end_snap: 90
End   Snapshot Id specified: 90
```

- Load profile
- In-use parameters
- Cache sizes and stats
- Shared pool stats
- Top 5 events
- Wait events
- SQL statement stats
- Tablespace IO
- File IO
- etcetera…
AWR Baselines

- Create baselines for comparisons
- Create during typical performance period

```sql
SQL> select snap_id, begin_interval_time from dba_hist_snapshot
   2  where to_char(begin_interval_time, 'mmddyyyy') = '07282004';

SNAP_ID BEGIN_INTERVAL_TIME
---------- ---------------------------------------------------
  91 28-JUL-04 03.46.49.000 PM
  84 28-JUL-04 01.00.31.991 AM
  ... 28-JUL-04 07.00.37.603 PM
  94 28-JUL-04 09.00.34.111 PM

SQL> exec dbms_workload_repository.create_baseline(start_snap_id=>85, -
   >         end_snap_id=>95, baseline_name=>'weekday load')

PL/SQL procedure successfully completed.
```
ADDM

- Automatic Database Diagnostic Monitor
  - Some say “Adam”
- Uses AW Repository to produce “findings”
  - Tuning recommendations
  - Goal: Improve overall system throughput
- Executes automatically after every snapshot
  - DBA can use to tune database
- Use OEM or DBMS_ADVISOR to configure and perform on-demand analysis
  - See supplied script
    $ORACLE_HOME/rdbms/admin/addmrpt.sql
ADDMD Report Excerpt

SQL> @%ORACLE_HOME%\rdbms\admin\addmrpt
Enter value for begin_snap: 105
Enter value for end_snap: 107

FINDING 2: 81% impact (537 seconds)

SQL statements were found waiting for row lock waits.

RECOMMENDATION 1: Application Analysis, 81% benefit (537 seconds)
ACTION: Trace the cause of row contention in the application logic.
   Use given blocked SQL to identify the database objects involved.
   Investigate application logic involving DML on these objects.
RATIONALE: The SQL statement with SQL_ID "4x1uh87xsn0m" was
   blocked on row locks.
RELEVANT OBJECT: SQL statement with SQL_ID 4x1uh87xsn0m
   update dave.t set c1 = 100

SYMPTOMS THAT LED TO THE FINDING:
   Wait class "Application" was consuming significant database time.
   (81% impact [538 seconds])
Enabling ADDM...

- `_ADDM_AUTO_ENABLE = TRUE` to enable
- `FALSE` to turn off
- Oracle does not recommend
- Must do your research on ramifications
- Enabled by default

```sql
SQL> select ksppinm, ksppdesc, ksppstvl
      2  from x$ksppi, x$ksppcv
      3  where x$ksppi.indx = x$ksppcv.indx
      4  and x$ksppi.ksppinm like '_addm%';
```

<table>
<thead>
<tr>
<th>KSPPINM</th>
<th>KSPPDESC</th>
<th>KSPPSTVL</th>
</tr>
</thead>
<tbody>
<tr>
<td>_addm_auto_enable</td>
<td>governs whether ADDM</td>
<td>TRUE</td>
</tr>
<tr>
<td></td>
<td>gets run automatically after every AWR snapshot</td>
<td></td>
</tr>
</tbody>
</table>
Enabling ADDM

- STATISTICS_LEVEL = TYPICAL
- Adjust advisor parameter DBIOEXPECTED*
  - Average Single Block Read Time
  - Set with DBMS_ADVISOR package
SQL Tuning Advisor…

- STA identifies issues and provides recommendations
  - Missing stats
  - Different plan
  - Different access paths and object
  - Restructuring SQL

- Oracle claims
  - “automates entire tuning process”
  - “replaces manual SQL tuning”

Could be a bit overstated…
...SQL Tuning Advisor

- Two interfaces
  - Enterprise Manager
  - API with supplied PL/SQL package
    - DBMS_SQLTUNE

- Three step process
  - Create tuning “task”
    - Stored persistently in data dictionary
  - Execute tuning task
    - Executes the optimizer in “Plan Tuning Analysis mode”
    - Gathers additional info
    - Creates a “profile” when warranted (more later)
  - Display report
    - Contains “findings” and possible solutions

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SQL Tuning Advisor Demo (1)

- Create a “tuning task”
- Execute the task
  - Invokes cost-based optimizer

```plsql
SYSTEM> declare
  2    task_id varchar2(30);
  3  begin
  4    task_id := dbms_sqltune.create_tuning_task(
  5                 sql_text=>'update dave.t set c1 = 6000',
  6                 task_name=>'test2');
  7
  8    dbms_sqltune.execute_tuning_task('test2');
  9  end;
10  /

PL/SQL procedure successfully completed.
```

Privileges req’d: ADVISOR, SELECT_CATALOG_ROLE, EXECUTE on DBMS_SQLTUNE

Source of SQL can be ADDM
SQL Tuning Advisor Demo (2)

Display the report

```sql
SYSTEM> set long 1000
SYSTEM> set linesize 120
SYSTEM> select dbms_sqltune.report_tuning_task('test2') from dual;

DBMS_SQLTUNE.REPORT_TUNING_TASK('TEST2')

----------------------------------------------------
GENERAL INFORMATION SECTION
----------------------------------------------------
Tuning Task Name       : test2
Scope                  : COMPREHENSIVE
Time Limit(seconds)    : 1800
Completion Status      : COMPLETED
Started at             : 08/02/2004 17:49:29
Completed at           : 08/02/2004 17:49:30

1st section of report gives general information
SQL Tuning Advisor Demo (3)

FINDINGS SECTION (1 finding)

1- Statistics Finding

Table "DAVE"."T" was not analyzed.

Recommendation

DBMS_SQLTUNE.REPORT_TUNING_TASK('TEST2')

Consider collecting optimizer statistics for this table.
execute dbms_stats.gather_table_stats(ownname => 'DAVE', tabname => 'T',
estimate_percent => DBMS_STATS.AUTO_SAMPLE_SIZE, method_opt => 'FOR

Clean up

SYSTEM> exec dbms_sqltune.drop_tuning_task('test2');
PL/SQL procedure successfully completed.
SQL Profiles

- Additional statistics and information for CBO
- Changes normal decision of CBO at run-time
  - Sort of like a hint
  - Without specifying the hint
  - Useful for packaged apps?
    - e.g. Peoplesoft, SAP
- Created *when warranted* - by SQL Tuning Advisor
  - When run in COMPREHENSIVE mode
  - Stored in dictionary
- Don’t confuse with stored outlines
  - Profile can change over time
  - How? Details???
SQL Profile Demo (1)

Run STA in comprehensive mode on query

SQL Text: select /*+ full(big) */ * from big where object_id = 1

FINDINGS SECTION (1 finding)

1- SQL Profile Finding (see explain plans section below)

A potentially better execution plan was found for this statement.

Recommendation (estimated benefit: 99.66%)

Consider accepting the recommended SQL profile

Forcing a full scan for this test

Mystery: how to see the better execution plan – before accepting?
SQL Profile Demo (2)

Accept the profile

```sql
DAVE> var x varchar2(30)
DAVE> begin
  2  :x := dbms_sqltune.accept_sql_profile
      (task_name=>'profile_test',
       name=>'profile_test_profile');
  3  end;
  4  /
PL/SQL procedure successfully completed.
```

Doc says this is a procedure – NOT.

Can limit use by session with “CATEGORY” attributes
SQL Profile Demo (3)

Test – is profile used?

DAVE> set autotrace traceonly
DAVE> select /*+ full(big) */ * from big where object_id = 1;

no rows selected

Execution Plan
----------------------------------------------------------
0  SELECT STATEMENT Optimizer=ALL_ROWS (Cost=2 Card=1
1  0  TABLE ACCESS (BY INDEX ROWID) OF 'BIG' (TABLE) (C
2  1  INDEX (RANGE SCAN) OF 'BIG_IDX' (INDEX) (Cost=1

YES. Profile is used.

DAVE> exec dbms_sqltune.drop_sql_profile('profile_test_profile')
PL/SQL procedure successfully completed.

Cleanup
Other Advisors

- SQL Access Advisor (1)
  - “…advice on materialized views, indexes, and materialized view logs”
- Undo Advisor (2)
  - Assists with sizing Undo tablespace
- Redo log Advisor (2)
  - Suggest log size
  - Reduce I/O from checkpointing
- Segment Advisor (2)
  - Fragmentation?
  - Can space be reclaimed?

Other notable undo features:
- Set retention = 0. Oracle will manage
- Eliminate “snapshot too old” errors
  - See RETENTION GUARANTEE on CREATE UNDO TABLESPACE
- Can cause DML to fail
Automatic Optimizer Statistics

- DB installation creates a scheduled daily job
  
  SQL> select last_start_date, last_run_duration
  2    from dba_scheduler_jobs
  3    where job_name = 'GATHER_STATS_JOB';
  
  31-JUL-04 10.00.03.904000 AM -04:00
+000000000 00:01:25.814000

- Collects only if stats stale or missing

- Set STATISTICS_LEVEL = TYPICAL
  
  See new auto-monitoring feature
  
  Extension of 9i Table Monitoring feature

Part of new “Scheduler” feature. See dbms_scheduler package and DBA_SCHEDULER_JOBS
More Optimizer Stats

- Collect data dictionary statistics

```sql
SYSDBA> exec dbms_stats.gather_dictionary_stats
PL/SQL procedure successfully completed.
```

- Auto parallel for DBMS_STATS

```sql
DAVE> exec dbms_stats.gather_schema_stats(user, -
>     cascade=>TRUE, -
>     method_opt=>'FOR ALL INDEXED COLUMNS', -
>     options=>'GATHER STALE', -
>     degree=>dbms_stats.auto_degree)
PL/SQL procedure successfully completed.
```
Rule-Based Optimization

- Still exists, but not supported
- OPTIOMIZER_MODE considerations
  - CHOOSE or RULE causes ALERT.LOG warning
  - ALL.Rows is the default
- CHOOSE and RULE hints not supported
- Migrate existing apps to CBO
  - Helpful documentation:
    - Oracle Database Upgrade Guide
    - Metalink Doc 189702.1
    - Oracle Database Performance Tuning Guide
Finding Wait Events...

- Improved V$ views related to wait events
- `V$SESSION_WAIT_CLASS`
  - Wait “classes” for grouping

```sql
DAVE> select wait_class, sum(total_waits), sum(time_waited)
   2   from v$session_wait_class
   3   group by wait_class order by sum(time_waited) desc;
```

<table>
<thead>
<tr>
<th>WAIT_CLASS</th>
<th>SUM(TOTAL_WAITS)</th>
<th>SUM(TIME_WAITED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle</td>
<td>524213</td>
<td>213386445</td>
</tr>
<tr>
<td>System I/O</td>
<td>125248</td>
<td>51796</td>
</tr>
<tr>
<td>User I/O</td>
<td>7393</td>
<td>14291</td>
</tr>
<tr>
<td>Other</td>
<td>15009</td>
<td>10487</td>
</tr>
<tr>
<td>Configuration</td>
<td>320966</td>
<td>460</td>
</tr>
<tr>
<td>Concurrency</td>
<td>75820</td>
<td>222</td>
</tr>
<tr>
<td>Commit</td>
<td>51</td>
<td>29</td>
</tr>
</tbody>
</table>
```

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...Finding Wait Events

- **V$SESSION_WAIT**
  - New columns eliminate need to join for cause of wait
- **V$ACTIVE_SESSION_HISTORY** keeps history of wait events for session
  - Reduces problem of hard-to-capture, transient wait events
  - Reduces re-runs to find problems
- More views to research...
More Features

- Self-Tuning Checkpointing
  - Set FAST_START_MTTR_TAR GET > 0
- Enhanced trace
  - See the DBMS_MONITOR package
- Sorted Hash Clusters
  - Rows kept in sort order
- Default dynamic sampling level now 2, not 1
  - More aggressive than 9i default
- Auto UNDO Tuning
- Shared Server enhancements
  - MTS_ parameters obsolete
- Resource Manager Enhancements
- Flush buffer cache
  - Why?

SYSDBA> alter system flush buffer_cache;
System altered.

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Watch Out For...

- ASM instance
  - Load on small servers
- OEM DBControl
  - Load on small servers
  - Many SYSMAN sessions
- Bug?:

```sql
SQL> alter system set sga_target=100m scope=both;
System altered.

SQL> show parameter sga_
NAME TYPE VALUE
----------------------- ----------- --------
sga_max_size big integer 200M
sga_target  big integer 16M
```

ASM instance killed performance of my test platform (W2000, 512M memory)

OEM Windows service sometimes fails to start on my machine

Will not be able to start DB. Backup SPFILE first!!!
SYSDBA> create pfile from spfile;
...Watch Out For

- Performance hit or usefulness of all the automatic stuff?
  - I’m not saying you won’t benefit, but test, especially
    - AWR (repository) and ADDM (diagnostics)
    - Automatic optimizer statistics collection
    - Automatic SGA Management
    - New OEM
At the start, we may be concerned about all new automatic stuff
- Overhead?
- Losing control?

Still some mysteries
- Lots of testing to do

Visit www.skillbuilders.com
- Download complete presentation (with some notes)
- Download demo scripts
- I’ll publish more papers as I learn more

AWR, Snapshots, Scheduled jobs, etcetera
We didn’t have time for...

- Default permanent tablespace
- SYSAUX Tablespace
- Bigfiles
- Rename tablespace
- Temporary tablespace groups
- Drop database
- Shrink objects
Flashback
ASM
Job Scheduler
RMAN
Tuning
More….

Thanks for listening!
Please call SkillBuilders for your training needs:
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