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Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

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**Using Flashback Technology II**

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**Objectives**

After completing this lesson, you should be able to: ฺ

• Describe and use Oracle Total Recall

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**> Total Recall Flashback Drop**

– Creating and enabling a Flashback Data Archive (FDA)

l

i

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a

– Managing FDAs

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– Viewing metadata

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• Describe and use flashback recycle bins

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– Restore dropped tables from the recycle bin

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– Manage space usage in the recycle bin

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– Query the recycle bin

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**Oracle Database 11*g*: Administration Workshop II 11 - 2**

**Oracle Total Recall Overview**

Automated tracking of historical database changes: ฺ

• Enable at the table level with your specified retention

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period.

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• All subsequent changes are transparently stored and

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tamper proof.

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• Records older than retention period are automatically d

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removed.

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• Use Flashback technologies to retrieve history.

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**SELECT … AS OF TIMESTAMP…**

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**SELECT … VERSIONS BETWEEN TIMESTAMP and TIMESTAMP…**

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**Use Cases for Flashback**

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**updates Base history queries**

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**Table **

**Flashback Data  Archive**

**request: Audit, compliance, historical reports, ILM**

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**Oracle Total Recall Overview**

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The Oracle Total Recall option in Oracle Database 11*g* (also known as Flashback Data Archive)

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provides a mechanism for tracking changes to production databases that is secure, efficient, easy to

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use, and application transparent.

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With Oracle Total Recall technology, you can automatically track and store the data in tables enabled

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for Flashback Data Archive. This ensures that flashback queries obtain SQL-level access to the

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versions of database objects without getting a snapshot-too-old error.

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o

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A Flashback Data Archive provides the ability to track and store all transactional changes to a

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“tracked” table over its life time. It is no longer necessary to build this intelligence into your d

o

application. You can use Oracle Total Recall for compliance, audit reports, data analysis, and

r

p

decision-support systems. The Flashback Data Archive background process starts with the database.

e

r

d

**Use case examples**:

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• Audit support: Find duplicate insurance claims from the last year.

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• Compliance support: Monitor stock trading during a quiet period.

h

t

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• Information Lifecycle Management (ILM): Guarantee immutable access to patient history. a

n

• Retention policy enforcement: Automatically purge records older than five years. U

• Historical reporting: Retrieve a client’s credit and payment history.

• Error Recovery: Restore records erroneously removed or updated.

**Oracle Database 11*g*: Administration Workshop II 11 - 3**

**Setup Process**

1. Create a new tablespace to hold the FDA.

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2. With the FLASHBACK ARCHIVE ADMINISTER system

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privilege: Create a Flashback Data Archive, assign it to the

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tablespace, and specify its retention period.

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**CREATE FLASHBACK ARCHIVE fda1**

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**TABLESPACE fda\_tbs1 QUOTA 10M RETENTION 1 YEAR;**

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3. With the FLASHBACK ARCHIVE object privilege: Alter the

e

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base tables to enable archiving and assign it to a flashback

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archive.

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**ALTER TABLE HR.EMPLOYEES FLASHBACK ARCHIVE fda1;**

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**Flashback**

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**Data**

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**Base table Archive**

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**Flashback Data Archive Process**

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A Flashback Data Archive consists of one or more tablespaces. You can have multiple Flashback

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Data Archives. They are configured with retention duration. Based on your retention duration

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requirements, you should create different Flashback Data Archives—for example, one for all records

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that must be kept for two years, another for all records that must be kept for five years. The database

s

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will automatically purge all historical information on the day after the retention period expires.

r

o

1. Create a tablespace for your Flashback Data Archive. The size depends on the base table and the

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expected DML and DDL activity.

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2. Create a Flashback Data Archive with retention time. Data archived in the Flashback Data u

d

Archive is retained for the retention time. This task requires the FLASHBACK ARCHIVE

o

r

ADMINISTER system privilege. If different retention periods are needed, different archives

p

e

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must be created.

d

3. Enable flashback archiving (and then disable it again) for a (whole) table. This task requires the

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i

FLASHBACK ARCHIVE object privilege. Although flashback archiving is enabled for a table,

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some DDL statements are not allowed on that table. By default, flashback archiving is off for

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any table.

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**Oracle Database 11*g*: Administration Workshop II 11 - 4**

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**D**

**How Total Recall Works**

History data:

• Row captured asynchronously by background processes at self-tuned intervals (default: 5 min) • Stored compressed and partitioned

• Automatically purged per

retention policy

d

**Original data in**

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**buffer cache**

**undo**

**Undo data**

O

**L**

**fbda background**

**fbda slaves (as needed) . . .**

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210

**MD**

**process help history data**

• Partitions automatically created

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based on time and volume

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• Unrelated partitions skipped by

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queries

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**EMPLOYEES FDA1**

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**How Total Recall Works**

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History data is captured from undo (and buffer cache) by the fdba background process at self-tuned

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intervals. The default is every five minutes. The entire base table row that is updated is stored, no

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matter how many columns are updated.

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• History data is compressed using OLTP Table compression, not Hybrid Columnar compression.

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**Note:** If the base table is compressed with Hybrid Columnar compression, the table cannot be

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enabled for Flashback Data Archiving.

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• Each flashback archive partition is at least 1 day and 1 MB of data, partitioned on ENDSCN.

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c

Flashback queries to the archives avoid unrelated partitions.

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d

• Up to ten flashback archiver slaves can be called upon by the fbda process.

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• If the flashback archive process and slaves are too busy, archiving may be performed inline,

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which significantly affects the user’s response time.

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**Oracle Database 11*g*: Administration Workshop II 11 - 5**

**Oracle Total Recall Scenario**

Using Flashback Data Archive to access historical data: ฺ

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**-- create the Flashback Data Archive**

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**CREATE FLASHBACK ARCHIVE DEFAULT fla1**

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f

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**TABLESPACE tbs1 QUOTA 10G RETENTION 5 YEAR;**

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**-- Specify the default Flashback Data Archive**

d

**2**

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**ALTER FLASHBACK ARCHIVE fla1 SET DEFAULT;**

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**-- Enable Flashback Data Archive**

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**ALTER TABLE inventory FLASHBACK ARCHIVE;**

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**ALTER TABLE stock\_data FLASHBACK ARCHIVE;**

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**SELECT product\_number, product\_name, count FROM inventory AS** h

g

**OF TIMESTAMP TO\_TIMESTAMP ('2007-01-01 00:00:00', 'YYYY-MM**

i

r

y

**DD HH24:MI:SS');**

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C

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**Oracle Total Recall Scenario**

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p

You create a Flashback Data Archive with the CREATE FLASHBACK ARCHIVE statement.

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• You can optionally specify the default Flashback Data Archive for the system.

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• You need to provide the name of the Flashback Data Archive.

b

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t

• You need to provide the name of the first tablespace of the Flashback Data Archive.

s

i

d

• You can identify the maximum amount of space that the Flashback Data Archive can use in the

r

o

tablespace. The default is unlimited. Unless your space quota on the first tablespace is unlimited,

n

you must specify this value, or else an ORA-55621 will ensue.

o

i

t

c

• You need to provide the retention time (number of days that Flashback Data Archive data for the u

d

table is guaranteed to be stored).

o

r

In the first example shown in the slide, a default Flashback Data Archive named fla1 is created that

p

e

r

uses up to 10 GB of the tbs1 tablespace, whose data will be retained for five years. In the second

d

e

example, the default Flashback Data Archive is specified. By default, the system has no Flashback

z

i

r

Data Archive. You can set it in one of two ways:

o

h

• Specify the name of an existing Flashback Data Archive in the SET DEFAULT clause of the

t

u

ALTER FLASHBACK ARCHIVE statement.

a

n

• Include DEFAULT in the CREATE FLASHBACK ARCHIVE statement when you create a U

Flashback Data Archive.

In the third example, Flashback Data Archive is enabled. If Automatic Undo Management is disabled, you receive an ORA-55614 if you try to modify the table.

**Oracle Database 11*g*: Administration Workshop II 11 - 6**

**Oracle Total Recall Scenario**

Optionally, adding space:

ฺ

s

**ALTER FLASHBACK ARCHIVE fla1**

e

**4**

t

**ADD TABLESPACE tbs3 QUOTA 5G;**

a

i

l

i

f

f

Optionally, changing retention time:

a

s

t

i

r

**5**

**ALTER FLASHBACK ARCHIVE fla1 MODIFY RETENTION 2 YEAR;**

o

/

d

Optionally, purging data:

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

n

a

e

l

**ALTER FLASHBACK ARCHIVE fla1 PURGE BEFORE TIMESTAMP**

c

**6**

a

r

**(SYSTIMESTAMP - INTERVAL '1' day);**

O

,

2

Optionally, dropping a Flashback Data Archive:

1

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**DROP FLASHBACK ARCHIVE fla1;**

**7**

©

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h

g

i

r

y

p

o

C

ฺ

d

e

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t

i

b

i

h

o

**Oracle Total Recall Scenario (continued)**

r

p

To enable flashback archiving for a table, include the FLASHBACK ARCHIVE clause in either the

n

o

i

CREATE TABLE or ALTER TABLE statement. In the FLASHBACK ARCHIVE clause, you can

t

u

specify the Flashback Data Archive where the historical data for the table will be stored. The default

b

i

r

t

is the default Flashback Data Archive for the system. To disable flashback archiving for a table,

s

i

d

specify NO FLASHBACK ARCHIVE in the ALTER TABLE statement.

r

o

The last statement shown in the previous slide shows how to retrieve the inventory of all items at the n

o

beginning of the year 2007. Continuing the previous examples:

i

t

c

• Example 4 adds up to 5 GB of the tbs3 tablespace to the fla1 Flashback Data Archive.

u

d

• Example 5 changes the retention time for the fla1 Flashback Data Archive to two years.

o

r

• Example 6 purges all historical data older than one day from the fla1 Flashback Data Archive.

p

e

r

Normally, purging is done automatically on the day after your retention time expires. You can

d

e

also override this for ad hoc clean-up.

z

i

r

• Example 7 drops the fla1 Flashback Data Archive and historical data, but not its tablespaces. o

h

With the ALTER FLASHBACK ARCHIVE command, you can:

t

u

- Change the retention time of a Flashback Data Archive

a

n

- Purge some or all of its data

U

- Add, modify, and remove tablespaces

**Note:** Removing all tablespaces of a Flashback Data Archive causes an error.

**Oracle Database 11*g*: Administration Workshop II 11 - 7**

**Transparent Schema Evolution**

• DDL support for:

ฺ

s

– Add, drop, rename, and modify column

e

t

a

i

– Drop and truncate partition

l

i

f

f

a

– Rename and truncate table

s

t

i

**Flashback Version**

r

o

/d

**1**

**2**

**3**

**1**

**Query **

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

n

**n**

a

e

lc

a

r

O

,

21

**p**

**o**

**r**

**D**

**n**

**m**

**u**

**lo**

**C**

**time**

**m**

**u**

**l**

**o**

**c**

**dd**

**A**

**2**

**3**

• Flashback queries work across DDL changes.

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2

• All other DDL is *not* automatically supported (see next

©

t

h

slide).

g

i

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d

e

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t

i

b

i

h

o

**Transparent Schema Evolution**

r

p

The most common DDL commands are possible with Flashback Data Archives. When a schema has

n

o

i

evolved in any of the ways listed in the slide, Total Recall automatically keeps track of the changes.

t

u

Flashback query appropriately returns the row or rows with the corresponding schema (as shown in

b

i

r

t

the diagram).

s

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d

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p

e

r

d

e

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U

**Oracle Database 11*g*: Administration Workshop II 11 - 8**

**Full Schema Evolution**

Disassociate or associate procedures in the

DBMS\_FLASHBACK\_ARCHIVE package:

ฺ

s

e

t

• Disable Total Recall on specified tables and allow more

a

i

l

i

f

complex DDL (upgrades, split tables, and so on).

f

a

s

t

• Enforce schema integrity during association. (Base table

i

r

o

and history table must be the same schema.)

/

d

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable n

**Note:** This function should be used with care and with the

a

e

l

understanding that the archive can no longer be guaranteed to

c

a

r

be immutable because the history could have been altered

O

,

during the time of disassociation.

2

1

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**1 2**

©

**Base Alter schema Table**

t

**disassociate**

h

g

i

r

**History**

y



**associate **

**Alter schema**

**Table History** 

p

**Table** o

C

d

e

ti

bi

h

o

r

**4**

ฺ

**Full Schema Evolution**

**3 **

****

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p

All DDL changes that are not automatically supported can be executed through the

n

o

i

DBMS\_FLASHBACK\_ARCHIVE package. You can use the DISASSOCIATE\_FBA and

t

u

REASSOCIATE\_FBA procedures to disassociate and reassociate a given table from its Flashback

b

i

r

t

Data Archive.

s

i

d

**Note:** This function should be used with care and with the understanding that the archive can no

r

o

longer be guaranteed to be immutable, because the history could have been altered during the time of n

o

disassociation. The system catalog has a note when the disassociation occurred.

i

t

c

u

The diagram in the slide shows the following workflow:

d

o

• If you have the FLASHBACK ARCHIVE ADMINISTER privilege, you can disassociate the

r

p

archive from the base table.

e

r

• Make the necessary changes to the base table.

d

e

• Make the necessary changes to the corresponding archive.

z

i

r

• Then you associate the table with the archive within the same schema. Total Recall validates

o

h

t

that the schemas are the same upon association.

u

a

n

U

**Oracle Database 11*g*: Administration Workshop II 11 - 9**

**Restrictions**

• You cannot enable Total Recall for base tables with Hybrid ฺ

Columnar compression.

s

e

t

a

• If disassociate is used, immutability of history is no longer

i

l

i

f

f

guaranteed (but you could always purge history previously

a

s

t

anyway with the right privilege).

i

r

o

/

• There is no transportability of history tables.

d

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**Restrictions**

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Some DDL statements cause error ORA-55610 when used on a table enabled for Flashback Data

n

o

i

Archive. For example:

t

u

• ALTER TABLE statement that includes an UPGRADE TABLE clause, with or

b

i

r

t

without an INCLUDING DATA clause

s

i

d

• ALTER TABLE statement that moves or exchanges a partition or subpartition operation

r

o

• DROP TABLE statement

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o

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**Oracle Database 11*g*: Administration Workshop II 11 - 10**

**Guidelines**

• Use SCN for precise queries.

ฺ

*or*

s

e

t

a

i

• Use Flashback technology for your convenience.

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i

f

f

a

• Flashback uses current system settings.

s

t

i

r

• Ensure database consistency with a COMMIT or ROLLBACK

o

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d

operation before querying past data.

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

n

a

• You cannot retrieve past data from a dynamic performance

e

l

c

a

(V$) view. They contain current data.

r

O

,

• However, you can perform queries on past data in static

2

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data dictionary views, such as \*\_TABLES.

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**Guidelines**

r

p

• Use Flashback Query, Flashback Version Query, or Flashback Transaction Query for SQL code

n

o

i

that you write, for convenience.

t

u

• Remember that all flashback processing uses the current session settings, such as national

b

i

r

t

language and character set, not the settings that were in effect at the time being queried.

s

i

d

• To query past data at a precise time, use an SCN. If you use a time stamp, the actual time queried

r

o

might be up to 3 seconds earlier than the time you specify. Oracle Database uses SCNs

n

internally and maps them to time stamps at a granularity of 3 seconds.

o

i

t

c

• To obtain an SCN to use later with a flashback feature, you can use the

u

d

DBMS\_FLASHBACK.GET\_SYSTEM\_CHANGE\_NUMBER function.

o

r

• To compute or retrieve a past time to use in a query, use a function return value as a time-stamp

p

e

r

or SCN argument. For example, add or subtract an INTERVAL value to the value of the

d

SYSTIMESTAMP function.

e

z

i

• To ensure database consistency, always perform a COMMIT or ROLLBACK operation before

r

o

h

querying past data.

t

u

• You cannot retrieve past data from a dynamic performance (V$) view. A query on such a view

a

n

always returns current data. However, you can perform queries on past data in static data U

dictionary views, such as \*\_TABLES.

**Oracle Database 11*g*: Administration Workshop II 11 - 11**

**Viewing Flashback Data Archives**

Viewing the results:

ฺ

s

**View Name (DBA/USER)**

e

**Description**

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a

i

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i

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f

a

s

ti

r

o

/d

\*\_FLASHBACK\_ARCHIVE \*\_FLASHBACK\_ARCHIVE\_TS

Displays information about Flashback  



Data Archives 



















Displays tablespaces of Flashback Data

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a

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lc

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\*\_FLASHBACK\_ARCHIVE\_TABLES

Archives

Displays information about tables that are enabled for flashback archiving

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i

h

o

**Viewing Flashback Data Archives**

r

p

You can use the dynamic data dictionary views to view tracked tables and Flashback Data Archive

n

o

i

metadata. To access the USER\_FLASHBACK\_\* views, you must have table ownership privileges.

t

u

To inspect the DBA\_FLASHBACK\_\* views, you need SYSDBA privileges.

b

i

r

t

s

For more details, see the *Advanced Application Developer's Guide* and the *PL/SQL Packages and*

i

d

*Types Reference*.

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**Oracle Database 11*g*: Administration Workshop II 11 - 12**

**Quiz**

You cannot drop, but you can truncate, a table that is tracked ฺ

by Oracle Total Recall.

s

e

t

a

1. True

i

l

i

f

f

2. False

a

s

t

i

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Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

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**Answer: 1**

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**Oracle Database 11*g*: Administration Workshop II 11 - 13**

**Quiz**

Select all correct statements about Oracle Total Recall: ฺ

1. Oracle Total Recall is enabled by default.

s

e

t

a

i

2. A Flashback Data Archive provides the ability to track and

l

i

f

f

store all transactional changes to a “tracked” table over its

a

s

t

i

lifetime.

r

o

/

3. Dropping a column in a table enabled for Flashback Data d

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

n

a

Archive causes an error.

e

l

c

4. Flashback processing always uses the settings that were

a

r

O

in effect at the time of being queried.

,

2

1

5. Flashback uses the current session settings, such as

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national language and character set.

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o

**Answer: 2, 5**

r

p

n

o

i

t

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b

i

r

t

s

i

d

r

o

n

o

i

t

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z

i

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**Oracle Database 11*g*: Administration Workshop II 11 - 14**

**Flashback Drop**

**and the Recycle Bin**

**RECYCLEBIN=ON**

ฺ

s

e

**Total Recall**

**> Flashback Drop**

****

****

****

t



a





i



l



i





f



f





a





s







t





i







r







o







/









d

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

n

a

**DROP TABLE employees; FLASHBACK TABLE**

e

l

c

**employees**

a

r

O

**TO BEFORE DROP;** 

,

2



1

**By mistake **

0

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e

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t

i

b

i

h

o

**Flashback Drop and the Recycle Bin**

r

p

Using the FLASHBACK TABLE command, you can undo the effects of a DROP TABLE statement

n

o

i

without having to use point-in-time recovery.

t

u

b

**Note:** The RECYCLEBIN initialization parameter is used to control whether the Flashback Drop

i

r

t

capability is turned ON or OFF. If the parameter is set to OFF, then dropped tables do not go into the

s

i

d

recycle bin. If this parameter is set to ON, the dropped tables go into the recycle bin and can be

r

o

recovered. By default, RECYCLEBIN is set to ON.

n

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r

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e

z

i

r

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**Oracle Database 11*g*: Administration Workshop II 11 - 15**

**Recycle Bin**

**BIN$zbjrBdpw==$0 EMPLOYEES**

**BIN$zbjra9wy==$0 EMPLOYEES\_PK**

ฺ

s

e

t

a

i

l

i

**4**

f

f

a

s

t

i

**DBA\_FREE\_SPACE**

r

o

/

d













**Recycle bin** 

****

****

****

****

****

****

**EMPLOYEES**

**BIN$zbjrBdpw==$0**

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

n

a

e

lc

a

r

O

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210

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©t

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gi

r

y

**3**

**EMPLOYEES\_PK BIN$zbjra9wy==$0 Objects are:**

– **Renamed** 

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– **Not moved**

**1**

po

C

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d

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**2**

**Recycle Bin**

**DROP TABLE employees;**

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Without the recycle bin enabled, when you drop a table, the space associated with the table and its

n

o

i

dependent objects is immediately reclaimable (that is, it can be used for other objects).

t

u

b

If the recycle bin is enabled, when you drop a table, then the space associated with the table and its

i

r

t

s

dependent objects is not immediately reclaimable, even though it does appear in

i

d

DBA\_FREE\_SPACE. Instead, the dropped objects are referenced in the recycle bin and still belong

r

o

to their owner. The space used by recycle bin objects is never automatically reclaimed unless there is n

o

space pressure. This enables you to recover recycle bin objects for the maximum possible duration.

i

t

c

u

When a dropped table is “moved” to the recycle bin, the table and its associated objects and d

o

constraints are renamed using system-generated names. The renaming convention is as follows:

r

p

e

BIN$unique\_id$version

r

d

where unique\_id is a 26-character globally unique identifier for this object making the recycle bin

e

z

i

name unique across all databases and version is a version number assigned by the database.

r

o

h

t

u

a

n

U

**Oracle Database 11*g*: Administration Workshop II 11 - 16**

**Recycle Bin (continued)**

The recycle bin itself is a data dictionary table that maintains the relationships between the original names of dropped objects and their system-generated names. You can query the recycle bin by using the DBA\_RECYCLEBIN view. The diagram in the previous slide illustrates this behavior: 1. You have created a table called EMPLOYEES in your tablespace.

2. You drop the EMPLOYEES table.

3. The extents occupied by EMPLOYEES are now considered as free space.

ฺ

s

4. EMPLOYEES is renamed and the new name is recorded into the recycle bin.

e

t

a

i

l

i

f

f

a

s

t

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d

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**Oracle Database 11*g*: Administration Workshop II 11 - 17**

**Restoring Tables from the Recycle Bin**

• Restore dropped tables and dependent objects.

ฺ

• If multiple recycle bin entries have the same original name:

s

e

t

a

i

– Use unique, system-generated names to restore a particular

l

i

f

f

version

a

s

t

i

– When using original names, the restored table is last in, first

r

o

/

out (LIFO)

d

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable n

• Rename the original name if that name is currently used.

a

e

l

c

a

r

O

**FLASHBACK TABLE <table\_name> TO BEFORE DROP**

,

2

**[RENAME TO <*new\_name*>];**

1

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i

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C

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e

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t

i

b

i

h

**Restoring Tables from the Recycle Bin**

o

r

p

Use the FLASHBACK TABLE ... TO BEFORE DROP command to recover a table and all of its

n

o

i

possible dependent objects from the recycle bin. You can specify either the original name of the table

t

u

or the system-generated name assigned to the object when it was dropped.

b

i

r

t

If you specify the original name, and if the recycle bin contains more than one object of that name,

s

i

d

then the object that was moved to the recycle bin most recently is recovered first (LIFO: last in, first

r

o

out). If you want to retrieve an older version of the table, you can specify the system-generated name n

o

of the table that you want to retrieve, or issue additional FLASHBACK TABLE ... TO BEFORE

i

t

c

DROP statements until you retrieve the table you want.

u

d

o

If a new table of the same name has been created in the same schema since the original table was

r

p

dropped, then an error is returned unless you also specify the RENAME TO clause.

e

r

d

**Note:** When you flash back a dropped table, the recovered indexes, triggers, and constraints keep e

z

their recycle bin names. Therefore, it is advisable to query the recycle bin and DBA\_CONSTRAINTS

i

r

o

before flashing back a dropped table. In this way, you can rename the recovered indexes, triggers,

h

t

and constraints to more usable names.

u

a

n

U

**Oracle Database 11*g*: Administration Workshop II 11 - 18**

**Recycle Bin: Automatic Space Reclamation**

**Recycle bin**

ฺ

s





e







t



a

i

l

**2**

i

f

f

a

s

t







i



**BIN$zbjrBdpw==$0  **

r



o



**BIN$zbjra9wy==$0** 

/

**BIN$zbjrBdpw==$0**

d

Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable 

n

a

e

l

c

a

r

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,

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**BIN$zbjra9wy==$0**

**DBA\_FREE\_SPACE - RECYCLEBIN**

**1**

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t

h

g

i

**Autoextend**

r

**3**

y

p

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C

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e

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t

i

b

i

h

**Recycle Bin: Automatic Space Reclamation**

o

r

p

As long as the space used by recycle bin objects is not reclaimed, you can recover those objects by

n

o

i

using Flashback Drop. The following are recycle bin object reclamation policies:

t

u

• Manual cleanup when you explicitly issue a PURGE command

b

i

r

t

• Automatic cleanup under space pressure: While objects are in the recycle bin, their

s

i

corresponding space is also reported in DBA\_FREE\_SPACE because their space is

d

r

o

automatically reclaimable. The free space in a particular tablespace is then consumed in the

n

following order:

o

i

t

1. Free space not corresponding to recycle bin objects

c

u

2. Free space corresponding to recycle bin objects. In this case, recycle bin objects are

d

o

r

automatically purged from the recycle bin using a first in, first out (FIFO) algorithm.

p

e

3. Free space automatically allocated if the tablespace is auto-extensible. Suppose that you

r

d

create a new table inside the TBS1 tablespace. If there is free space allocated to this

e

z

i

tablespace that does not correspond to a recycle bin object, this free space is used as a first

r

o

step. If this is not enough, free space is used that corresponds to recycle bin objects that

h

t

u

reside inside TBS1. If the free space of some recycle bin objects is used, these objects are

a

n

purged automatically from the recycle bin. At this time, you can no longer recover these U

objects by using the Flashback Drop feature. As a last resort, the TBS1 tablespace is extended (if possible) if the space requirement is not yet satisfied.

**Oracle Database 11*g*: Administration Workshop II 11 - 19**

**Recycle Bin: Manual Space Reclamation**

**PURGE {TABLE <table\_name>|INDEX <index\_name>}**

ฺ

**PURGE TABLESPACE <ts\_name> [USER <user\_name>]**

s

e

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a

i

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i

f

**PURGE [USER\_|DBA\_]RECYCLEBIN**

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**Recycle Bin: Manual Space Reclamation**

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p

Use the PURGE command to permanently remove objects from the recycle bin. When an object is

n

o

i

purged from the recycle bin, the object and dependent objects are permanently removed from the

t

u

database. As a consequence, objects purged from the recycle bin are no longer recoverable by using

b

i

r

t

Flashback Drop. The following are possible uses of PURGE:

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i

• PURGE TABLE purges the specified table.

d

r

• PURGE INDEX purges the specified index.

o

n

• PURGE TABLESPACE purges all the objects residing in the specified tablespace. In addition,

o

i

t

objects residing in other tablespaces may get purged if they are dependent.

c

u

• PURGE RECYCLEBIN purges all the objects that belong to the current user. RECYCLEBIN and

d

o

r

USER\_RECYCLEBIN are synonymous.

p

e

• PURGE DBA\_RECYCLEBIN purges all the objects. You must have enough system privileges or

r

d

the SYSDBA system privilege to issue this command.

e

z

i

r

Tables can also be purged from the recycle bin using Enterprise Manager. On the Schema folder tab, o

h

click Tables, then select the schema the dropped object resided in and click the Recycle Bin button.

t

u

Select the table from the results list and click the Purge button.

a

n

U

**Note:** For PURGE TABLE and PURGE INDEX commands, if you specify an original name and if the recycle bin contains more than one object of that name, then the object that has been in the recycle bin the longest is purged first (FIFO).

**Oracle Database 11*g*: Administration Workshop II 11 - 20**

**Bypassing the Recycle Bin**

**DROP TABLE <table\_name> [PURGE] ;**

ฺ

s

e

t

**DROP TABLESPACE <ts\_name>**

a

i

l

i

f

**[INCLUDING CONTENTS] ;**

f

a

s

t

i

**DROP USER <user\_name> [CASCADE] ;**

r

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**Security considerations for the recycle bin:**

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**ALTER SYSTEM SET RECYCLEBIN=OFF SCOPE=SPFILE;**

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**Bypassing the Recycle Bin**

o

r

p

You can use the DROP TABLE PURGE command to permanently drop a table and its dependent n

o

objects from the database. When you use this command, the corresponding objects are not moved to

i

t

u

the recycle bin. This command provides the same functionality that the DROP TABLE command

b

i

r

t

provided in previous releases.

s

i

d

When you issue the DROP TABLESPACE ... INCLUDING CONTENTS command, the objects in

r

o

the tablespace are not placed in the recycle bin. Moreover, objects in the recycle bin belonging to the

n

tablespace are purged. When you issue the same command without the INCLUDING CONTENTS

o

i

t

c

clause, the tablespace must be empty for the command to succeed. However, there can be objects

u

d

belonging to the tablespace in the recycle bin. In this case, these objects are purged.

o

r

p

When you issue the DROP USER ... CASCADE command, the user and all the objects owned by the

e

r

user are permanently dropped from the database. Any objects in the recycle bin belonging to the

d

e

dropped user are purged.

z

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For increased security, you may decide to not allow the use of the recycle bin. Connected as

h

t

SYSDBA, you can:

u

a

• View the recycle bin status with:

n

U

SHOW PARAMETER RECYCLEBIN

• Disable the use of the recycle bin with:

ALTER SYSTEM SET RECYCLEBIN=OFF SCOPE=SPFILE;

After issuing this command, you need to restart the database.

**Oracle Database 11*g*: Administration Workshop II 11 - 21**

**Querying the Recycle Bin**

**SELECT owner, original\_name, object\_name,**

**type, ts\_name, droptime, related, space**

ฺ

s

e

**FROM dba\_recyclebin**

t

a

i

**WHERE can\_undrop = 'YES';**

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**SQL> SELECT original\_name, object\_name, ts\_name, droptime**

r

o

/

**FROM user\_recyclebin WHERE can\_undrop = 'YES';**

d

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n

a

**ORIGINAL\_NAME OBJECT\_NAME TS\_NAM DROPTIME**

e

l

c

**------------- ----------------------- ------ -------------------**

a

r

**EMPLOYEES2 BIN$NE4Rk64w...gbpQ==$0 USERS 2007-07-02:15:45:13**

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**SQL> SHOW RECYCLEBIN**

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**Querying the Recycle Bin**

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You can view all the objects that you have dropped by querying user\_recyclebin or n

o

RECYCLEBIN. It has a synonym RECYCLEBIN, for ease of use.

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The dba\_recyclebin view shows you all the objects that have been dropped by all users and that

b

i

r

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are still in the recycle bin.

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You can also use the SQL\*Plus SHOW RECYCLEBIN command. This command shows you only

r

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those objects that can be “undropped.”

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The examples show how to extract important information from the recycle bin:

c

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• original\_name is the name of the object before it is dropped.

d

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• object\_name is the system-generated name of the object after it is dropped.

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• type is the object’s type.

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• ts\_name is the name of the tablespace to which the object belongs.

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• droptime is the date at which the object was dropped.

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• related is the object identifier of the dropped object.

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• space is the number of blocks currently used by the object.

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You can also see the content of the recycle bin by using Database Control.

U

**Note:** For detailed information about the DBA\_RECYCLEBIN view, see the *Oracle Database Reference* guide.

**Oracle Database 11*g*: Administration Workshop II 11 - 22**

**Quiz**

When you flash back a dropped table, the recovered indexes, ฺ

triggers, and constraints keep their recycle bin names.

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**Answer: 1**

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**Oracle Database 11*g*: Administration Workshop II 11 - 23**

**Summary**

In this lesson, you should have learned how to: ฺ

• Set up and use Total Recall

s

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• Restore dropped tables from the recycle bin

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• Query the recycle bin

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**Oracle Database 11*g*: Administration Workshop II 11 - 24**

**Practice 11 Overview:**

**Using Flashback Technology**

This practice covers the following topics:

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• Using Total Recall

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• Recycle bin activities (*optional*)

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**Oracle Database 11*g*: Administration Workshop II 11 - 25**

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**Performing Flashback Database**

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**Objectives**

After completing this lesson, you should be able to: ฺ

• Configure Flashback Database

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• Perform Flashback Database operations

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• Monitor Flashback Database

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**Oracle Database 11*g*: Administration Workshop II 12 - 2**

**Flashback Database**

The Flashback Database operation:

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• Works like a rewind button for the database

s

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• Can be used in cases of logical data corruptions made by

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**Errors are**

**The**

**"Press the rewind button"**

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**generated.**

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**database is**

**(FLASHBACK DATABASE).**

**corrupted.**

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**database is "rewound."**

**Flashback Database**

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With Flashback Database, you can quickly bring your database to an earlier point in time by undoing

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all the changes that have taken place since that time. This operation is fast because you do not need

t

u

to restore backups. You can use this feature to undo changes that have resulted in logical data

b

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corruptions.

s

i

d

When you use Flashback Database, the Oracle database uses past block images to back out changes

r

o

to the database. During normal database operation, the Oracle database occasionally logs these block n

o

images in flashback logs. Flashback logs are written sequentially and are not archived. The Oracle

i

t

c

database automatically creates, deletes, and resizes flashback logs in the Fast Recovery Area. You

u

d

need to be aware of flashback logs only for monitoring performance and deciding how much disk

o

r

p

space to allocate for them in the Fast Recovery Area.

e

r

The time it takes to rewind a database with Flashback Database is proportional to how far back in

d

e

time you need to go and the amount of database activity after the target time. The time it would take

z

i

r

to restore and recover the whole database could be much longer. The before images in the flashback

o

h

t

logs are used only to restore the database to a point in the past, and forward recovery is used to bring

u

a

the database to a consistent state at some time in the past. The Oracle database returns data files to

n

U

the previous point in time, but not auxiliary files, such as initialization parameter files. Flashback Database can also be used to compliment Data Guard and Recovery Advisor, and for synchronizing duplicated databases.

**Oracle Database 11*g*: Administration Workshop II 12 - 3**

**Flashback Database Architecture**

**SGA**

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s

**Not every**

e

**Redo log**

t

**change!**

a

**buffer**

i

**Flashback**

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**Buffer cache**

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**buffer**

**Periodically**

**Every change**

**LGWR**

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**RVWR Flashback logs**

**log block**

**before images**

**Do forward**

**Redo logs**

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**Back out changes**

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**1**

**to database using before images.**

**media recovery.**

**2**

**… …**

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C

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**Flashback Database Architecture**

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When you enable Flashback Database, the RVWR (Flashback Writer) background process is started.

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This background process sequentially writes Flashback Database data from the flashback buffer to

t

u

the Flashback Database logs, which are circularly reused. Subsequently, when a FLASHBACK

b

i

r

t

DATABASE command is issued, the flashback logs are used to restore to the blocks’ before images,

s

i

d

and then redo data is used to roll forward to the desired flashback time.

r

o

The overhead of enabling Flashback Database depends on the read/write mix of the database n

o

workload. Because queries do not need to log any flashback data, the more write-intensive the

i

t

c

workload, the higher the overhead of turning on Flashback Database.

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**Oracle Database 11*g*: Administration Workshop II 12 - 4**

**Configuring Flashback Database**

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**1. Configure the**

**2. Set the retention**

**3. Enable Flashback**

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**FRA.**

**SQL> SHUTDOWN IMMEDIATE SQL> STARTUP MOUNT**

**target.**

**Database.**

If your database is in ARCHIVELOG mode, there is no need to

**SQL> ALTER DATABASE ARCHIVELOG;**

1

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restart it.

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**SQL> ALTER SYSTEM SET**

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**2 DB\_FLASHBACK\_RETENTION\_TARGET=2880 SCOPE=BOTH;**

t

h

**SQL> ALTER DATABASE FLASHBACK ON;**

g

i

r

With open database

y

**SQL> ALTER DATABASE OPEN;**

p

o

C

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d

e

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i

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**Configuring Flashback Database**

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p

You can configure Flashback Database as follows:

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1. Configure the Fast Recovery Area.

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2. Set the retention target with the DB\_FLASHBACK\_RETENTION\_TARGET initialization

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i

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parameter. You can specify an upper limit, in minutes, on how far back you want to be able to

s

i

d

flash back the database. The example uses 2,880 minutes, which is equivalent to two days. This

r

o

parameter is only a target and does not provide any guarantee. Your flashback time interval

n

depends on how much flashback data has been kept in the Fast Recovery Area.

o

i

t

c

3. Enable Flashback Database with the following command:

u

d

ALTER DATABASE FLASHBACK ON;

o

r

Before you can issue the command to enable Flashback Database, the database must be

p

e

configured for archiving.

r

d

e

You can determine whether Flashback Database is enabled with the following query:

z

i

r

SELECT flashback\_on FROM v$database;

o

h

t

You can disable Flashback Database with the ALTER DATABASE FLASHBACK OFF command. As u

a

a result, all existing Flashback Database logs are deleted automatically.

n

U

**Note:** You can enable Flashback Database only when the database is mounted in exclusive mode, not open.

**Oracle Database 11*g*: Administration Workshop II 12 - 5**

**What You Need to Do**

Configuration work flow:

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1. Make sure that the

s

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database is in

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ARCHIVELOG mode.

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2. Enable flashback

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logging and specify

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the Fast Recovery

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**What You Need to Do**

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Log in to Enterprise Manager (EM). On the Availability page, select Recovery Settings in the

n

o

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Backup/Recovery region. Make sure that your database is in ARCHIVELOG mode. If not, select

t

u

ARCHIVELOG Mode and then click Continue. You need to shut down and restart the instance for

b

i

r

t

your changes to take effect.

s

i

d

When the Fast Recovery Area and archiving are configured, USE\_DB\_RECOVERY\_FILE\_DEST is

r

o

configured for archive log destination 10. Enable flashback logging by selecting Enable Flashback n

o

Logging. You can also set the flashback retention time and view important information regarding

i

t

c

your flashback database window.

u

d

o

Review the Fast Recovery Area location. The Fast Recovery Area is a unified storage location for all

r

p

recovery-related files and activities in an Oracle database. All files that are needed to completely

e

r

recover a database from a media failure are part of the Fast Recovery Area. The recovery-related

d

e

files that can be created in the Fast Recovery Area include: archived redo log files, control files,

z

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backups created by Recovery Manager (RMAN), flashback logs, and the change tracking file. By

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allocating a storage location and unifying recovery-related files within a specific area, the Oracle

u

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database server relieves the database administrator from having to manage the disk files created by

n

U

these components. The default location for the Fast Recovery Area is

$ORACLE\_BASE/flash\_recovery\_area. If you would like it in a different location, change it now. Scroll down to the bottom of the Recovery Settings page and click Apply.

**Oracle Database 11*g*: Administration Workshop II 12 - 6**

**Flashback Database: Examples**

• To flash back: Mounted (in exclusive mode) database ฺ

**RMAN> FLASHBACK DATABASE TO TIME =**

s

e

t

**2> "TO\_DATE('2009-05-27 16:00:00',**

a

i

l

i

**3> 'YYYY-MM-DD HH24:MI:SS')";**

f

f

a

s

t

i

**RMAN> FLASHBACK DATABASE TO SCN=23565;**

r

o

**RMAN> FLASHBACK DATABASE**

/

d

Monitor progress of Flashback Database with the

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**2> TO SEQUENCE=223 THREAD=1;**

n

a

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c

**SQL> FLASHBACK DATABASE**

a

r

**2 TO TIMESTAMP(SYSDATE-1/24);**

O

,

**SQL> FLASHBACK DATABASE TO SCN 53943;**

2

1

V$SESSION\_LONGOPS view.

**SQL> FLASHBACK DATABASE TO RESTORE POINT b4\_load;**

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t

• To review changes: Read-only opened database

h

g

i

r

• To finalize: Read/write opened database with RESETLOGS

y

p

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C

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t

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**Flashback Database: Examples**

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p

You can use the RMAN FLASHBACK DATABASE command to execute the Flashback Database

n

o

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operation. You can use SEQUENCE and THREAD to specify a redo log sequence number and thread

t

u

as a lower limit. RMAN selects only files that can be used to flash back to, but not including, the

b

i

r

t

specified sequence number.

s

i

d

Alternatively, you can use the SQL FLASHBACK DATABASE command to return the database to a

r

o

past time or SCN. If you use the TO SCN clause, you must provide a number. If you specify TO n

o

TIMESTAMP, you must provide a time stamp value. You can also specify a restore point name.

i

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c

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You can monitor the Flashback Database progress with the V$SESSION\_LONGOPS view. d

o

r

**Note:** The database must be mounted in exclusive mode to issue the FLASHBACK DATABASE p

e

command and opened read-only to review changes. The database must be opened read/write with the

r

d

RESETLOGS option when finished.

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**Oracle Database 11*g*: Administration Workshop II 12 - 7**

**Flashback Database Considerations**

• When the Flashback Database operation completes, open ฺ

the database:

s

e

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– In read-only mode to verify that the correct target time or

i

l

i

f

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SCN was used

a

s

– With a RESETLOGS operation to allow DML

t

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• The opposite of “flash back” is “recover.”

d

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n

a

• You cannot use Flashback Database in the following

e

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situations:

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– The control file has been restored or re-created.

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– A tablespace has been dropped.

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– A data file has been reduced in size.

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• Use the TO BEFORE RESETLOGS clause to flash back to

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before the last RESETLOGS operation.

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**Flashback Database Considerations**

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In situations where you cannot use the Flashback Database feature, you should use an incomplete

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recovery operation to return the database to a specific time. After the Flashback Database operation

t

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is complete, you can open the database in read-only mode to verify that the correct target time or

b

i

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SCN was used. If not, you can flash back the database again, or perform a recovery to roll forward

s

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the database. So, to undo a Flashback Database operation, you should recover the database forward.

r

o

You cannot use Flashback Database to recover a data file that was dropped during the span of time n

o

you are flashing back. The dropped data file is added to the control file and marked offline, but it is

i

t

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not flashed back. Flashback Database cannot flash back a data file to a time after its creation and

u

d

before the resize operation. If a file was resized during the span of time to which you are going to

o

r

p

flash back the database, then you should take the file offline before beginning the Flashback

e

r

Database operation. This is applicable for files that are shrunk rather than expanded. You can use d

e

Flashback Database with data files that you have configured for automatic extension. You can flash

z

i

r

back to just before the last RESETLOGS operation by supplying the TO BEFORE RESETLOGS

o

h

clause in the FLASHBACK DATABASE command.

t

u

a

**Note:** The flashback retention target is not an absolute guarantee that flashback will be available. If

n

U

space is needed for required files in the Fast Recovery Area, flashback logs may be deleted automatically.

**Oracle Database 11*g*: Administration Workshop II 12 - 8**

**Monitoring Flashback Database**

To monitor the ability to meet your retention target: ฺ

• View the Fast Recovery Area disk quota:

s

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a

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i

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**SQL> SELECT estimated\_flashback\_size,**

f

a

**2 flashback\_size**

s

t

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**3 FROM V$FLASHBACK\_DATABASE\_LOG;**

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• Determine the current flashback window:

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**SQL> SELECT oldest\_flashback\_scn,**

c

a

r

**2 oldest\_flashback\_time**

O

**3 FROM V$FLASHBACK\_DATABASE\_LOG;**

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• Monitor logging in the Flashback Database logs:

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**SQL> SELECT \***

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**2 FROM V$FLASHBACK\_DATABASE\_STAT;**

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**Monitoring Flashback Database**

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It is important for you to monitor space usage of the Fast Recovery Area so that you know how well

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you are meeting your retention target. Use the V$FLASHBACK\_DATABASE\_LOG view to monitor

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the Flashback Database retention target:

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• ESTIMATED\_FLASHBACK\_SIZE uses previously logged flashback data to provide an

s

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estimate of how much disk space is needed in the Fast Recovery Area for flashback logs to meet

r

o

the current flashback retention target. The estimate is based on the workload since the instance

n

was started, or during the most recent time interval equal to the flashback retention target,

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whichever is shorter.

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• FLASHBACK\_SIZE gives you the current size, in bytes, of the flashback data.

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• OLDEST\_FLASHBACK\_SCN and OLDEST\_FLASHBACK\_TIME display the approximate

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lowest SCN and time to which you can flash back your database. CURRENT\_SCN in

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V$DATABASE gives you the current database SCN.

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Use the V$FLASHBACK\_DATABASE\_STAT view to monitor the overhead of logging flashback

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data in the Flashback Database logs. This view contains 24 hours of information, with each row

t

u

representing a one-hour time interval. You can use this view to determine rate changes in the

a

n

flashback data generation.

U

SQL> SELECT begin\_time, end\_time, flashback\_data, db\_data, 2 redo\_data, estimated\_flashback\_size AS EST\_FB\_SZE

3 FROM V$FLASHBACK\_DATABASE\_STAT;

**Oracle Database 11*g*: Administration Workshop II 12 - 9**

**Monitoring Flashback Database (continued)**

BEGIN\_TIM END\_TIME FLASHBACK\_DATA DB\_DATA REDO\_DATA EST\_FB\_SZE --------- --------- -------------- ---------- ---------- ---------- 12-FEB-09 12-FEB-09 16384 0 24576 0 12-FEB-09 12-FEB-09 6594560 7471104 1533440 815923200 12-FEB-09 12-FEB-09 17235968 12361728 5150920 839467008 12-FEB-09 12-FEB-09 311648256 37249024 10272768 855195648

Based on this information, you may need to adjust the retention time or the Fast Recovery Area size.

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FLASHBACK\_DATA and REDO\_DATA represent the number of bytes of flashback data and redo data

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written, respectively, during the time interval, and DB\_DATA gives the number of bytes of data

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a

blocks read and written. This view also contains the estimated flashback space needed for the

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interval.

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You can query V$RECOVERY\_FILE\_DEST to view information regarding the Fast Recovery Area.

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d

The column descriptions are:

/u01/flash\_recovery\_area 5368707120 2507809104 203386880 226 Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable

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• **NAME:** Fast Recovery Area name, indicating location string

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• **SPACE\_LIMIT:** Disk limit specified in the DB\_RECOVERY\_FILE\_DEST\_SIZE parameter

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• **SPACE\_USED:** Space used by Fast Recovery Area files (in bytes)

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• **SPACE\_RECLAIMABLE:** Amount of space that can be reclaimed by deleting obsolete,

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redundant, and other low-priority files through the space management algorithm

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• **NUMBER\_OF\_FILES:** Number of files

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SQL> SELECT name, space\_limit AS quota,

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2 space\_used AS used,

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3 space\_reclaimable AS reclaimable,

C

4 number\_of\_files AS files

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5 FROM v$recovery\_file\_dest ;

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NAME QUOTA USED RECLAIMABLE FILES

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

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**Oracle Database 11*g*: Administration Workshop II 12 - 10**

**Monitoring Flashback Database with EM**

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lowest SCN, and the time of the lowest SCN in the flashback data. Tran Van Binh (tranbinh48ca@gmailฺcom) has a non-transferable 

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**Monitoring Flashback Database with EM**

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Most of the Flashback Database statistics mentioned on the preceding pages can be viewed from the

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Recovery Settings page. These metrics include the current space used by all flashback logs, the

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**Oracle Database 11*g*: Administration Workshop II 12 - 11**

**Guaranteed Restore Points**

A guaranteed restore point ensures that you can perform a ฺ

FLASHBACK DATABASE command to that SCN at any time.

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**SQL> CREATE RESTORE POINT before\_upgrade**

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**2 GUARANTEE FLASHBACK DATABASE;**

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**Guaranteed Restore Points**

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Like normal restore points, guaranteed restore points can be used as aliases for SCNs in recovery

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operations. A principal difference is that guaranteed restore points never age out of the control file

t

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and must be explicitly dropped. However, they also provide specific functionality related to the use

b

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of the Flashback Database feature.

s

i

d

Creating a guaranteed restore point at a particular SCN enforces the requirement that you can

r

o

perform a Flashback Database operation to return your database to its state at that SCN, even if n

o

flashback logging is not enabled for your database. If flashback logging is enabled, creating a

i

t

c

guaranteed restore point enforces the retention of flashback logs required for Flashback Database

u

d

back to any point in time after the creation of the earliest guaranteed restore point.

o

r

p

A guaranteed restore point can be used to revert a whole database to a known good state days or

e

r

weeks ago, as long as there is enough disk space in the Fast Recovery Area to store the needed logs.

d

e

As with normal restore points, guaranteed restore points can be used to specify a point in time for

z

i

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RECOVER DATABASE operations.

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**Note:** Limitations that apply to Flashback Database also apply to guaranteed restore points. For a

n

example, shrinking a data file or dropping a tablespace can prevent flashing back the affected data U

files to the guaranteed restore point.

**Oracle Database 11*g*: Administration Workshop II 12 - 12**

**Flashback Database and**

**Guaranteed Restore Points**

To use guaranteed restore points, the database must satisfy ฺ

the following prerequisites:

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t

• The COMPATIBLE initialization parameter must be set to

a

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i

f

f

10.2 or greater.

a

s

t

i

• The database must be running in ARCHIVELOG mode.

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• FLASHBACK DATABASE requires the use of archived redo d

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n

a

logs starting from around the time of the restore point.

e

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c

• A Fast Recovery Area must be configured.

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**Flashback Database and Guaranteed Restore Points**

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p

To support the use of guaranteed restore points, the database must satisfy the following prerequisites:

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i

• The COMPATIBLE initialization parameter must be set to 10.2 or greater.

t

u

• The database must be running in ARCHIVELOG mode.

b

i

r

t

• To rewind the database to a guaranteed restore point, the FLASHBACK DATABASE command

s

i

d

needs the archived redo logs starting from around the time of the restore point.

r

o

• A Fast Recovery Area must be configured. Guaranteed restore points use a mechanism similar to

n

flashback logging. As with flashback logging, the Oracle database must store the required logs

o

i

t

c

in the Fast Recovery Area.

u

d

• If Flashback Database is not enabled, then the database must be mounted, not open, when

o

r

creating the first guaranteed restore point (or if all previously created guaranteed restore points

p

e

r

have been dropped).

d

e

Logging for Flashback Database and guaranteed restore points involves capturing images of data file

z

i

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blocks before changes are applied. The FLASHBACK DATABASE command can use these images to

o

h

t

return the data files to their previous state. The chief differences between normal flashback logging u

a

and logging for guaranteed restore points are related to when blocks are logged and whether the logs n

can be deleted in response to space pressure in the Fast Recovery Area. These differences affect U

space usage for logs and database performance.

**Oracle Database 11*g*: Administration Workshop II 12 - 13**

**Flashback Database and Guaranteed Restore Points (continued)**

If you enable Flashback Database and define one or more guaranteed restore points, then the database performs normal flashback logging. In this case, the recovery area retains the flashback logs required to flash back to any arbitrary time between the present and the earliest currently defined guaranteed restore point. Flashback logs are not deleted in response to space pressure if they are required to satisfy the guarantee.

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**Oracle Database 11*g*: Administration Workshop II 12 - 14**

**Quiz**

You can use Flashback Database, when you want to:

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1. Repair logical data corruptions

s

e

t

a

i

2. Recover a tablespace that has been dropped

l

i

f

f

a

3. Recover to a point prior to when a data file has been

s

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reduced in size

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4. Recover to a point prior to when you re-created the control

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file

**Answer: 1**

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**Oracle Database 11*g*: Administration Workshop II 12 - 15**

**Quiz**

Flashback logs are archived to allow you to rewind to a point in ฺ

time that your FRA cannot accommodate.

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a

1. True

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2. False

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**Answer: 2**

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**Oracle Database 11*g*: Administration Workshop II 12 - 16**

**Summary**

In this lesson, you should have learned how to: ฺ

• Configure Flashback Database

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a

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• Perform Flashback Database operations

l

i

f

f

a

• Monitor Flashback Database

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**Oracle Database 11*g*: Administration Workshop II 12 - 17**

**Practice 12 Overview:**

**Working with Flashback Database**

This practice covers the following topics:

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• Performing Flashback Database to undo unwanted

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transactions

i

l

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f

f

• Monitoring the Flashback Database retention

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• Determining the size of the flashback logs

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**Oracle Database 11*g*: Administration Workshop II 12 - 18**

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**Managing Memory**

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**Objectives**

After completing this lesson, you should be able to: ฺ

• Describe the memory components in the SGA

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• Implement Automatic Memory Management

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i

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• Manually configure SGA parameters

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• Configure automatic PGA memory management

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**Oracle Database 11*g*: Administration Workshop II 13 - 2**

**Memory Management: Overview**

DBAs must consider memory management to be a crucial part ฺ

of their job because:

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• There is a finite amount of memory available

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• Allocating more memory to serve certain types of functions

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can improve overall performance

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• Automatically tuned memory allocation is often the d

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appropriate configuration, but specific environments or

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even short-term conditions may require further attention

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**Memory Management: Overview**

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Because there is a finite amount of memory available on a database server and thus, on an Oracle

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database instance, you must pay attention to how memory is allocated. If too much memory is u

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allowed to be used by a particular area that does not need it, then there is the possibility that there are

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other functional areas unnecessarily doing without enough memory to perform optimally. With the

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ability to have memory allocation automatically determined and maintained for you, the task is

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simplified greatly. But even automatically tuned memory needs to be monitored for optimization and n

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may need to be manually configured to some extent.

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**Oracle Database 11*g*: Administration Workshop II 13 - 3**

**Reviewing Oracle Database Memory Structures** ฺ

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**Stack space**

**User**

**Global Area**

**Stack space**

**User**

**Global Area**

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**Server**

**process 1**

**Program Global Area (PGA)Server process 2**

**PGA**

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**Shared pool**

**Database buffer**

**cache**

**Redo log buffer**

**Keep**

**buffer pool**

**Recycle buffer pool**

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**Streams**

**pool Large pool Java pool System Global Area (SGA)**

**nK buffer cache**

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**Reviewing Oracle Database Memory Structures**

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Oracle Database creates and uses memory structures for various purposes. For example, memory

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stores program code being run, data that is shared among users, and private data areas for each u

b

connected user.

i

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Two basic memory structures are associated with an instance:

i

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• **System Global Area (SGA):** Group of shared memory structures, known as SGA components,

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that contain data and control information for one Oracle Database instance. The SGA is shared n

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by all server and background processes. Examples of data stored in the SGA include cached data

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blocks and shared SQL areas.

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• **Program Global Areas (PGA):** Memory regions that contain data and control information for a

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server or background process. A PGA is nonshared memory created by Oracle Database when a

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server or background process is started. Access to the PGA is exclusive to the server process. d

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Each server process and background process has its own PGA.

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**Oracle Database 11*g*: Administration Workshop II 13 - 4**

**Reviewing Oracle Database Memory Structures (continued)**

The SGA is the memory area that contains data and control information for the instance. The SGA includes the following data structures:

• **Shared pool:** Caches various constructs that can be shared among users

• **Database buffer cache:** Caches blocks of data retrieved from the database

• **KEEP buffer pool:** Is a specialized type of database buffer cache that is tuned to retain blocks of data in memory for long periods of time

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• **Recycle buffer pool:** Is a specialized type of database buffer cache that is tuned to recycle or

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remove block from memory quickly

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i

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• **nK buffer cache:** Is one of several specialized database buffer caches designed to hold block

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sizes different from the default database block size

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t

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• **Redo log buffer:** Caches redo information (used for instance recovery) until it can be written to

r

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the physical redo log files stored on the disk

d

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• **Large pool:** Is the optional area that provides large memory allocations for certain large

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processes, such as Oracle backup and recovery operations, and I/O server processes

l

c

• **Java pool:** Is used for all session-specific Java code and data in the Java Virtual Machine (JVM)

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• **Streams pool:** Is used by Oracle Streams to store information required by capture and apply

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When you start the instance by using Enterprise Manager or SQL\*Plus, the amount of memory

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allocated for the SGA is displayed.

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A Program Global Area (PGA) is a memory region that contains data and control information for

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each server process. An Oracle server process services a client’s requests. Each server process has its

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own private PGA that is created when the server process is started. Access to the PGA is exclusive to p

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that server process, and the PGA is read and written only by the Oracle code acting on its behalf.

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The PGA is divided into two major areas: stack space and the User Global Area (UGA). d

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With the dynamic SGA infrastructure, the sizes of the database buffer cache, the shared pool, the

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large pool, the Java pool, and the Streams pool can change without shutting down the instance.

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The Oracle database uses initialization parameters to create and manage memory structures. The

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simplest way to manage memory is to allow the database to automatically manage and tune it for

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you. To do so (on most platforms), you only have to set a target memory size initialization parameter

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(MEMORY\_TARGET) and a maximum memory size initialization parameter

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(MEMORY\_MAX\_TARGET).

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**Oracle Database 11*g*: Administration Workshop II 13 - 5**

**Buffer Cache**

**SGA**

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s

• Pinned

• Clean

• Free/unused • Dirty

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**Server**

**LRU lists**

**....**

**Checkpoint queue**

**....**

**DB buffer cache**

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**Buffer Cache**

**DB\_BLOCK\_SIZE**

**DB\_CACHE\_SIZE**

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**DBW*n***

**Data files**

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You can configure the buffer cache by specifying a value for the DB\_CACHE\_SIZE parameter. The

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buffer cache holds copies of the data blocks from the data files having a block size of u

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DB\_BLOCK\_SIZE. The buffer cache is a part of the SGA, so all users can share these blocks. The

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server processes read data from the data files into the buffer cache. To improve performance, the

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server process sometimes reads multiple blocks in a single read operation. The DBW*n* process writes

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data from the buffer cache into the data files. To improve performance, DBW*n* writes multiple blocks n

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in a single write operation.

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At any given time, the buffer cache may hold multiple copies of a single database block. Only one d

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current copy of the block exists, but to satisfy queries, server processes may need to construct read

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consistent copies from past image information. This is called a consistent read (CR) block.

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The least recently used (LRU) list reflects the usage of buffers. The buffers are sorted on the basis of

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a combination of how recently and how often they have been referenced. Thus, buffers that are most

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frequently and recently used are found at the most recently used end. Incoming blocks are copied to a

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buffer from the least recently used end, which is then assigned to the middle of the list, as a starting a

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point. From here, the buffer works its way up or down the list, depending on usage. U

**Oracle Database 11*g*: Administration Workshop II 13 - 6**

**Buffer Cache (continued)**

Buffers in the buffer cache can be in one of four states:

• **Pinned:** The block is either currently being read into the cache or being written to. Other sessions wait to access the block.

• **Clean:** The buffer is now unpinned and is a candidate for immediate aging out if the current contents (data block) are not referenced again. Either the contents are in sync with disk or the buffer contains a CR snapshot of a block.

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• **Free/unused:** The buffer is empty because the instance just started. This state is very similar to

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the clean state, except that the buffer has not been used.

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• **Dirty:** The buffer is no longer pinned but the contents (data block) have changed and must be

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flushed to disk by DBW*n* before it can be aged out.

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Server processes use the buffers in the buffer cache, but the DBW*n* process makes buffers in the cache

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available by writing changed buffers back to the data files. The checkpoint queue lists the buffers d

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that are to be written out to disk.

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Then Oracle database supports multiple block sizes in the same database. The standard block size is

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used for the SYSTEM tablespace. You specify the standard block size by setting the initialization

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parameter DB\_BLOCK\_SIZE. Legitimate values are from 2 KB to 32 KB, and the default is 8 KB.

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The cache sizes of nonstandard block size buffers are specified by the following parameters:

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• DB\_2K\_CACHE\_SIZE

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• DB\_4K\_CACHE\_SIZE

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• DB\_8K\_CACHE\_SIZE

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• DB\_16K\_CACHE\_SIZE

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• DB\_32K\_CACHE\_SIZE

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The DB\_*n*K\_CACHE\_SIZE parameters cannot be used to size the cache for the standard block size.

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If the value of DB\_BLOCK\_SIZE is *n*K, it is illegal to set DB\_*n*K\_CACHE\_SIZE. The size of the

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cache for the standard block size is always determined from the value of DB\_CACHE\_SIZE.

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Each buffer cache has a limited size, so typically not all the data on disk can fit in the cache. When

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the cache is full, subsequent cache misses cause the Oracle database to write dirty data already in the

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cache to disk to make room for the new data. (If a buffer is not dirty, it does not need to be written to

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disk before a new block can be read into the buffer.) Subsequent access to any data that was written

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to disk results in additional cache misses.

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The size of the cache affects the likelihood that a request for data will result in a cache hit. If the

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cache is large, it is more likely to contain the data that is requested. Increasing the size of a cache

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increases the percentage of data requests that result in cache hits.

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**Oracle Database 11*g*: Administration Workshop II 13 - 7**

**Using Multiple Buffer Pools**

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**SGA**

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**DB buffer caches**

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**Recycle pool**

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**DB\_RECYCLE\_CACHE\_SIZE**

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**Keep pool**

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**DB\_KEEP\_CACHE\_SIZE**

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**Default pool**

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**DB\_CACHE\_SIZE**

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**Using Multiple Buffer Pools**

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The database administrator (DBA) may be able to improve the performance of the database buffer

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cache by creating multiple buffer pools. You assign objects to a buffer pool depending on how the u

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objects are accessed. There are three buffer pools:

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• **Keep:** This pool is used to retain objects in memory that are likely to be reused. Keeping these

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objects in memory reduces I/O operations. Buffers are kept in this pool by ensuring that the pool

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is sized larger than the total size of the segments assigned to the pool. This means that buffers do n

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not have to be aged out. The keep pool is configured by specifying a value for the

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DB\_KEEP\_CACHE\_SIZE parameter.

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• **Recycle:** This pool is used for blocks in memory that have little chance of being reused. The

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recycle pool is sized smaller than the total size of the segments assigned to the pool. This means

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r

that blocks read into the pool will often have to age out a buffer. The recycle pool is configured d

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by specifying a value for the DB\_RECYCLE\_CACHE\_SIZE parameter.

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• **Default:** This pool always exists. It is equivalent to the buffer cache of an instance without a

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keep pool or a recycle pool and is configured with the DB\_CACHE\_SIZE parameter.

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**Note:** The memory in the keep or recycle pool is not a subset of the default buffer pool.

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**Oracle Database 11*g*: Administration Workshop II 13 - 8**

**Using Multiple Buffer Pools**

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**CREATE INDEX cust\_idx …**

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**STORAGE (BUFFER\_POOL KEEP);**

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**ALTER TABLE oe.customers**

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**STORAGE (BUFFER\_POOL RECYCLE);**

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**ALTER INDEX oe.cust\_lname\_ix**

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a

**STORAGE (BUFFER\_POOL KEEP);**

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**Using Multiple Buffer Pools (continued)**

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The BUFFER\_POOL clause is used to define the default buffer pool for an object. It is part of the

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STORAGE clause and is valid for CREATE and ALTER table, cluster, and index statements. The u

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blocks from an object without an explicitly set buffer pool go into the default buffer pool.

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The syntax is BUFFER\_POOL [KEEP | RECYCLE | DEFAULT].

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When the default buffer pool of an object is changed using the ALTER statement, blocks that are

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already cached remain in their current buffers until they are flushed out by the normal cache

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management activity. Blocks read from disk are placed into the newly specified buffer pool for the

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segment.

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Because buffer pools are assigned to a segment, objects with multiple segments can have blocks in

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multiple buffer pools. For example, an index-organized table can have different pools defined on

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both the index and the overflow segment.

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**Oracle Database 11*g*: Administration Workshop II 13 - 9**

**Shared Pool**

Contents:

• Library cache: Command text, parsed code, and execution ฺ

s

plan

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• Data dictionary cache: Definitions for tables, columns, and

l

i

f

f

privileges from the data dictionary tables

a

s

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• Result cache: Results from SQL queries and PL/SQL

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o

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functions

d

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a

• User Global Area (UGA):

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Session information for the

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Oracle shared server

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**Shared SQL area**

**Data dictionary cache**

**Result cache**

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**SHARED\_POOL\_SIZE**

**Library cache**

**UGA**

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**Shared Pool**

**Shared pool**

**SGA**

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You can specify the size of the shared pool with the SHARED\_POOL\_SIZE initialization parameter.

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The shared pool is a memory area that stores information shared by multiple sessions. It contains u

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different types of data, as shown in the graphic in the slide.

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**Library cache:** The library cache contains shared SQL and PL/SQL areas—the fully parsed or

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compiled representations of PL/SQL blocks and SQL statements. PL/SQL blocks include:

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• Procedures and functions

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• Packages

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• Triggers

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• Anonymous PL/SQL blocks

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**Data dictionary cache:** The data dictionary cache holds definitions of dictionary objects in memory.

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**Result cache:** The result cache comprises the SQL query result cache and PL/SQL function result

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cache. This cache is used to store results of SQL queries or PL/SQL functions to speed up their future

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execution.

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**User Global Area:** The UGA contains the session information for the Oracle shared server. The n

UGA is located in the shared pool when using a shared server session and if the large pool is not U

configured.

**Oracle Database 11*g*: Administration Workshop II 13 - 10**

**Large Pool**

• Provides large memory allocations for:

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– Session memory for the shared server and the Oracle XA

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interface

a

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i

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– I/O server processes

a

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– Oracle Database backup and restore operations

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– Parallel query operations

d

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– Advanced Queuing memory table storage

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• Reduces potential fragmentation of shared pool

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• Is managed by AMM and ASMM

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• Is sized with the LARGE\_POOL\_SIZE parameter

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**Large Pool**

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The database administrator can configure an optional memory area called the *large pool* to provide

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large memory allocations for:

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• Session memory for the shared server and the Oracle XA interface (used where transactions

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interact with multiple databases)

i

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• I/O server processes

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o

• Buffers for Recovery Manager (RMAN) I/O slaves

n

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• Message buffers used in the parallel execution of statements

i

t

c

• Advanced Queuing memory table storage

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By allocating session memory for the items listed in the slide, the shared pool has less fragmentation

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p

that would come from having large objects frequently allocated and deallocated in it. Segregating

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r

large objects out of the shared pool results in more efficient shared pool usage, which means more of

d

e

its memory is available to service new requests and to retain existing data if needed.

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The large pool can be automatically managed by AMM and ASMM. You can also size it with the

h

t

LARGE\_POOL\_SIZE parameter.

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**Oracle Database 11*g*: Administration Workshop II 13 - 11**

**Java Pool and Streams Pool**

• Java pool memory is used in server memory for all ฺ

session-specific Java code and data in the JVM.

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e

t

a

• Streams pool memory is used exclusively by Oracle

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i

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Streams to:

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– Store buffered queue messages

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– Provide memory for Oracle Streams processes

d

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**Shared pool**

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**Database buffer**

**cache**

**Redo log buffer**

**Keep**

**buffer pool**

**Recycle buffer pool**

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**Streams**

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**pool Large pool Java pool **

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**nK buffer cache **

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**Java pool Streams pool**

**System Global Area (SGA)**

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**Java Pool and Streams Pool**

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Java pool memory is used in server memory for all session-specific Java code and data in the JVM.

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Java pool memory is used in different ways, depending on the mode in which Oracle Database is u

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running.

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i

The Java Pool Advisor statistics provide information about library cache memory used for Java and

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predict how changes in the size of the Java pool can affect the parse rate. The Java Pool Advisor is

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internally turned on when statistics\_level is set to TYPICAL or higher. These statistics reset

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when the advisor is turned off.

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The Streams pool is used exclusively by Oracle Streams. The Streams pool stores buffered queue

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messages, and it provides memory for Oracle Streams capture processes and apply processes. p

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Unless you specifically configure it, the size of the Streams pool starts at zero. The pool size grows

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dynamically as needed when Oracle Streams is used.

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**Note:** A detailed discussion of Java programming and Oracle Streams is beyond the scope of this

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class.

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**Oracle Database 11*g*: Administration Workshop II 13 - 12**

**Redo Log Buffer**

• Is a circular buffer in the SGA

ฺ

• Holds information about changes made to the database

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• Contains redo entries that have the information to redo

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i

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changes made by operations such as DML and DDL

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Content transferred by log writer process (LGWR):

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– When a user process commits a transaction

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– When the redo log buffer is one-third full

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– Before a DBW*n* process writes modified buffers to disk

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**LGWR**

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**Redo log buffer LogWriter process Redo log files**

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**Redo Log Buffer**

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The Oracle server processes copy redo entries from the user’s memory space to the redo log buffer

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for each DML or DDL statement. The redo entries contain the information necessary to reconstruct u

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or redo changes made to the database by DML and DDL operations. They are used for database

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recovery and take up continuous sequential space in the buffer.

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The redo log buffer is a circular buffer; the server processes can copy new entries over the entries in

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the redo log buffer that have already been written to disk. The LGWR process normally writes fast

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enough to ensure that space is always available in the buffer for new entries. The LGWR process

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writes the redo log buffer to the active online redo log file (or members of the active group) on disk. d

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The LGWR process copies to disk all redo entries that have been entered into the buffer since the last

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time LGWR wrote to disk.

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**What Causes LGWR to Write?**

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LGWR writes out the redo data from the redo log buffer:

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• When a user process commits a transaction

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• Every three seconds, or when the redo log buffer is one-third full

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• When a DBW*n* process writes modified buffers to disk, if the corresponding redo log data has not U

already been written to disk

**Oracle Database 11*g*: Administration Workshop II 13 - 13**

**Automatic Memory Management: Overview**

With Automatic Memory Management, the database can size ฺ

the SGA and PGA automatically according to your workload.

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**Memory**

**Max Target**

**11*g***

**350 MB**

**Memory**

**Max Target**

**Memory Target**

**11*g***

**350 MB 300 MB**

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**Memory Target**

**250 MB**

**ALTER SYSTEM SET**

**MEMORY\_TARGET=300M;**

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**Oracle recommends the use of AMM unless you have special requirements.**

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**Automatic Memory Management: Overview**

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Automatic Memory Management (AMM) allows the Oracle Database to manage SGA memory and

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instance PGA memory sizing automatically. To do so (on most platforms), you set only a target

t

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memory size initialization parameter (MEMORY\_TARGET) and a maximum memory size

b

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initialization parameter (MEMORY\_MAX\_TARGET), and the database dynamically exchanges

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memory between the SGA and the instance PGA as needed to meet processing demands. You can

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enable AMM in Enterprise Manager by navigating to: Server > Memory Advisors (in the Database

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Configuration section) and then clicking the Enable button.

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With this memory management method, the database also dynamically tunes the sizes of the

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individual SGA components and the sizes of the individual PGAs.

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Because the target memory initialization parameter is dynamic, you can change the target memory p

size at any time without restarting the database. The maximum memory size serves as an upper limit

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so that you cannot accidentally set the target memory size too high. Because certain SGA

d

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components either cannot easily shrink or must remain at a minimum size, the database also prevents

z

i

r

you from setting the target memory size too low.

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This indirect memory transfer relies on the operating system (OS) mechanism of freeing shared

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memory. After memory is released to the OS, the other components can allocate memory by n

requesting memory from the OS. Currently, Automatic Memory Management is implemented on U

Linux, Solaris, HPUX, AIX, and Windows.

**Oracle Database 11*g*: Administration Workshop II 13 - 14**

**Oracle Database Memory Parameters**

**MEMORY\_MAX\_TARGET**

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**SGA\_MAX\_SIZE**

**MEMORY\_TARGET**

This enables AMM.

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**SGA\_TARGET**

**PGA\_AGGREGATE\_TARGET**

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–This enables ASMM. –Changing SGA\_TARGET affects only automatically sized components.

**Others**

Child parameters:

• Providing minimum values • Automatic change of size only

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**SHARED\_POOL\_SIZE**

**LOG\_BUFFER** with autotuned parameters **RESULT\_CACHE\_SIZE**

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**DB\_CACHE\_SIZE**

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**LARGE\_POOL\_SIZE JAVA\_POOL\_SIZE STREAMS\_POOL\_SIZE**

**DB\_KEEP\_CACHE\_SIZE**

**DB\_RECYCLE\_CACHE\_SIZE DB\_*n*K\_CACHE\_SIZE**

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**Oracle Database Memory Sizing Parameters**

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The graphic in the slide shows you the memory initialization parameters hierarchy. Although you

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have to set only MEMORY\_TARGET to trigger Automatic Memory Management, you still have the u

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possibility to set lower bound values for various caches. Therefore, if the child parameters are user

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set, they will be the minimum values below which the Oracle database server will not autotune that

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component.

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• If SGA\_TARGET and PGA\_AGGREGATE\_TARGET are set to a nonzero value, they are n

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considered to be the minimum values for the sizes of the SGA and the PGA, respectively.

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MEMORY\_TARGET can take values from SGA\_TARGET + PGA\_AGGREGATE\_TARGET to

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MEMORY\_MAX\_SIZE.

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• If SGA\_TARGET is set, the database autotunes only the sizes of the subcomponents of the SGA.

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PGA is autotuned independent of whether it is explicitly set or not. However, the whole d

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SGA(SGA\_TARGET) and the PGA (PGA\_AGGREGATE\_TARGET) are not autotuned—that is,

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do not grow or shrink automatically.

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**Oracle Database 11*g*: Administration Workshop II 13 - 15**

**Monitoring Automatic Memory Management**

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**Monitoring Automatic Memory Management**

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From the EM home page (Related Links section), navigate to Advisor Central > Memory Advisors.

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The Memory Advisors page is displayed in the slide.

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After Automatic Memory Management is enabled, you can see the graphical representation of the

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history of your memory size components in the Allocation History section of the Memory Advisors

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page. The top portion in the first histogram is tunable PGA only and the lower portion is all of SGA.

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The top portion in the second histogram is the shared pool size and the lower portion corresponds to

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the buffer cache.

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On this page, you can also access the memory target advisor by clicking the Advice button. This

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advisor gives you the possible DB time improvement for various total memory sizes. p

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**Note:** You can also look at the memory target advisor by using the

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V$MEMORY\_TARGET\_ADVISOR view.

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**Oracle Database 11*g*: Administration Workshop II 13 - 16**

**Monitoring Automatic Memory Management**

If you want to monitor the decisions made by Automatic ฺ

Memory Management via a command line:

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• V$MEMORY\_DYNAMIC\_COMPONENTS has the current status

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of all memory components

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• V$MEMORY\_RESIZE\_OPS has a circular history buffer of

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the last 800 memory resize requests

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• V$MEMORY\_TARGET\_ADVICE provides tuning advice for

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the MEMORY\_TARGET initialization parameter

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**Monitoring Automatic Memory Management (continued)**

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The dynamic performance view V$MEMORY\_DYNAMIC\_COMPONENTS shows the current sizes of

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all dynamically tuned memory components, including the total sizes of the SGA and instance PGA. u

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The V$MEMORY\_TARGET\_ADVICE view provides tuning advice for the MEMORY\_

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TARGET initialization parameter.

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When viewing the V$MEMORY\_TARGET\_ADVICE view, the row with the

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MEMORY\_SIZE\_FACTOR of 1 shows the current size of memory, as set by the MEMORY\_TARGET

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initialization parameter, and the amount of DB time required to complete the current workload. In

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previous and subsequent rows, the results show a number of alternative MEMORY\_TARGET sizes. For

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each alternative size, the database shows the size factor (the multiple of the current size), and the p

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estimated DB time to complete the current workload if the MEMORY\_TARGET parameter were

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changed to the alternative size. Notice that for a total memory size smaller than the current

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MEMORY\_TARGET size, estimated DB time increases.

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**Oracle Database 11*g*: Administration Workshop II 13 - 17**

**Efficient Memory Usage: Guidelines**

• Fit the SGA into physical memory.

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• Tune for a high buffer cache hit ratio, with the following

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caveats:

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– Even valid and necessary full table scans lower it.

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– It is possible that unnecessary repeated reads of the same

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blocks are artificially raising it.

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• Use the Memory Advisors.

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**Efficient Memory Usage: Guidelines**

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If possible, it is best to fit the SGA into physical memory, which provides the fastest access. Even

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though the OS may provide additional virtual memory, that memory, by its nature, can often be u

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swapped out to disk. On some platforms, you can use the LOCK\_SGA initialization parameter to lock

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the SGA into physical memory. This parameter cannot be used in conjunction with AMM or ASMM.

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When a SQL statement executes, data blocks are requested for reading or writing, or both. This is

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considered a logical I/O. As the block is requested, the block is checked to see whether it already

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exists in memory. If it is not in memory, it is read from the disk, which is called a physical I/O. The

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number of times the block is found already in memory compared to the total number of logical I/Os d

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is referred to as the buffer cache hit ratio. A higher ratio is usually better because that means more

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blocks are being found in memory without incurring disk I/O.

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It is not uncommon to have a buffer cache hit ratio above 99% but that does not always mean the

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system is well tuned. If there is a query that is executed more often than necessary, and it constantly

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requests the same blocks over and over again, the ratio is raised. If it is an inefficient or unnecessary

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query, then it artificially inflates the ratio. This is because it should not execute in that manner or that a

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often in the first place.

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**Oracle Database 11*g*: Administration Workshop II 13 - 18**