ORACLE

Oracle Recovery Manager (Rman)

Sessão exclusive – Accenture do Brasil

Marcel Lamarca
Exadata Cloud Specialist
Oracle, Alliances and Channels LAD
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SQL> select * from person where name = ‘Marcel Lamarca’

SCAN ME

MARCEL LAMARCA

Exadata Cloud Specialist

Upgrade, Utilities, Patching, Performance & Migrations

marcel-lamarca

marcel.lamarca@oracle.com

About My Career

- 22 Years dedicated to study and support Oracle Databases.
- 12 Years working with Exadata (On-prem, C@C and Cloud Services) .
- 5 Year working for Oracle do Brasil
- 2 Year on Alliances LAD knowledge Team

Certifications

Oracle Cloud Specialist (OCS)

- Exadata Database Machine X9M Certified Specialist
- OCI Foundation 2020 / 2023
- Oracle Autonomous Database Administrator Professional 2019 / 2023
- Oracle Cloud Database Migration and Integration 2021
- OCI Cloud Certified Architect Associate 2022
- OCI Cloud Certified Architect Professional 2022
- OCI Multi-Cloud Architect Professional 2023
- Oracle Database Services Certified Professional 2023

Oracle Certified Professional (OCP)

- Oracle Database certified professional 10g, 11g, 12c and 19c.
- Mysql 8.0 Database Administrator Certified Professional

Oracle Certified Specialist (OCE)

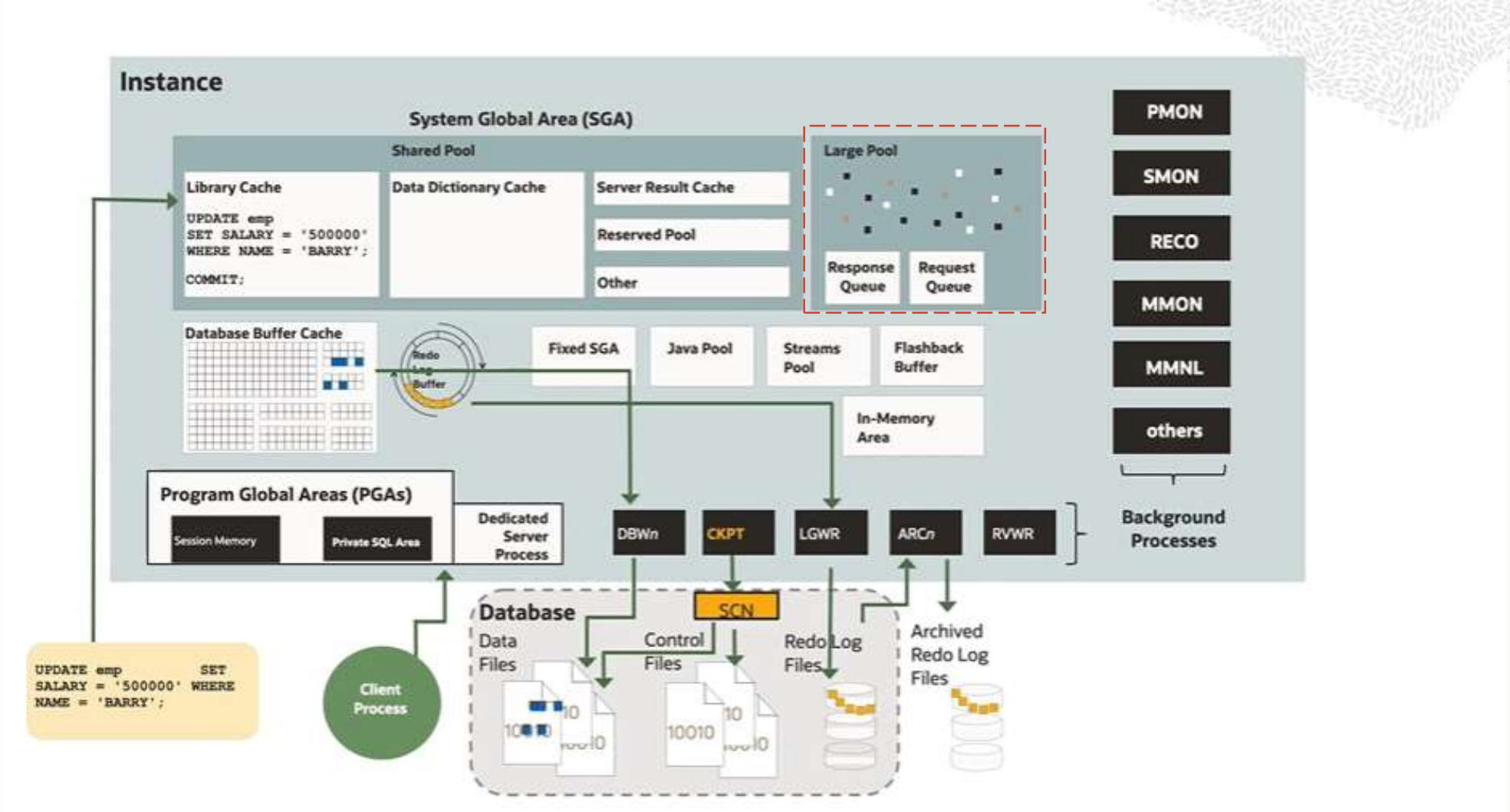
- Grid/RAC Database Administrator 11g
- Oracle Golden Gate 12c Certified Implementation Specialist

Agenda

1. Backup and Recovery Concepts
2. Using Recovery Manager (RMAN)
3. Backup and Recovery Strategies
4. Recovery Catalog

Oracle Database architecture

Oracle Database 19c Memory Diagram



Oracle Database 19c physical files and contents

Data Files

- Every Oracle Database has one or more physical **Data File**, which contain all the database data. The files contain logical database structures, such as tables and Indexes.

Control Files

- The **Control File** contains the metadata specifying the physical structure of the database, including the database name the names and location of the database files, and the **System Change Number (SCN)** for each Data Files. Oracle strongly recommends **automatic Control File enabled.**

On Line Redo Logs

- Every Oracle Database has an **online redo log**. Which is a set of two or more online redo log files. An online redo log is made up of redo entries (also called redo records), which record all changes made to data.

Parameter Files

- Every Oracle database has a **parameter file**, witch defines how the instance is configured and used during it starts up. Can be backed up with automatic **Control File backup.**

Oracle Database 19c SYSTEM Tablespace

Is the most important and is used to store **SYSTEM** metadata and includes data about tables, indexes, sequences, and other objects – this metadata comprises the data dictionary.

SYSTEM

- Required for every Oracle Database —it is the first tablespace created when a database is created.
- You cannot rename or drop a **SYSTEM**.
- You cannot take a **SYSTEM** Tablespace offline.
- This Tablespace always has a **SYSTEM** Undo segment.

Oracle Database 19c UNDO tablespace

This Tablespace contains reconstruction segments and has the ability to recover incomplete or aborted transactions. An undo segment is used to save the old value when a process changes data in a database.
The objectives of the undo segments are :

UNDO

- Roll back transactions when a ROLLBACK statement is issued
- Recover the database
- Provide read consistency
- Analyze data as of an earlier point in time by using Oracle **Flashback Query**
- Recover from logical corruptions using Oracle Flashback features

Oracle Database 19c Logical USERS and TEMP tablespaces

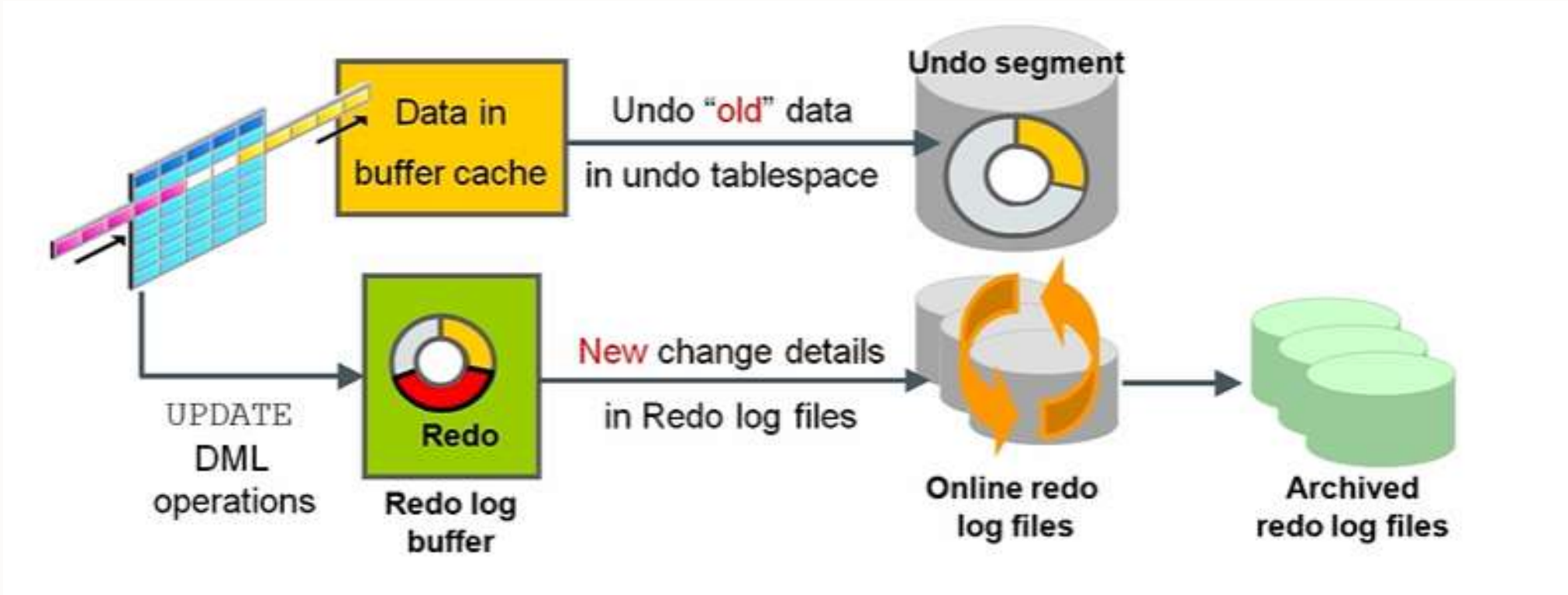
USERS

- This is generally the **default tablespace for users**. If a user creates an object. Without specifying the Tablespace, Oracle creates it in the **user's default**.

TEMP

- Oracle generally uses this Tablespace to store transient objects during classifications and groupings. The TEMP **is the least critical in the database precisely.**

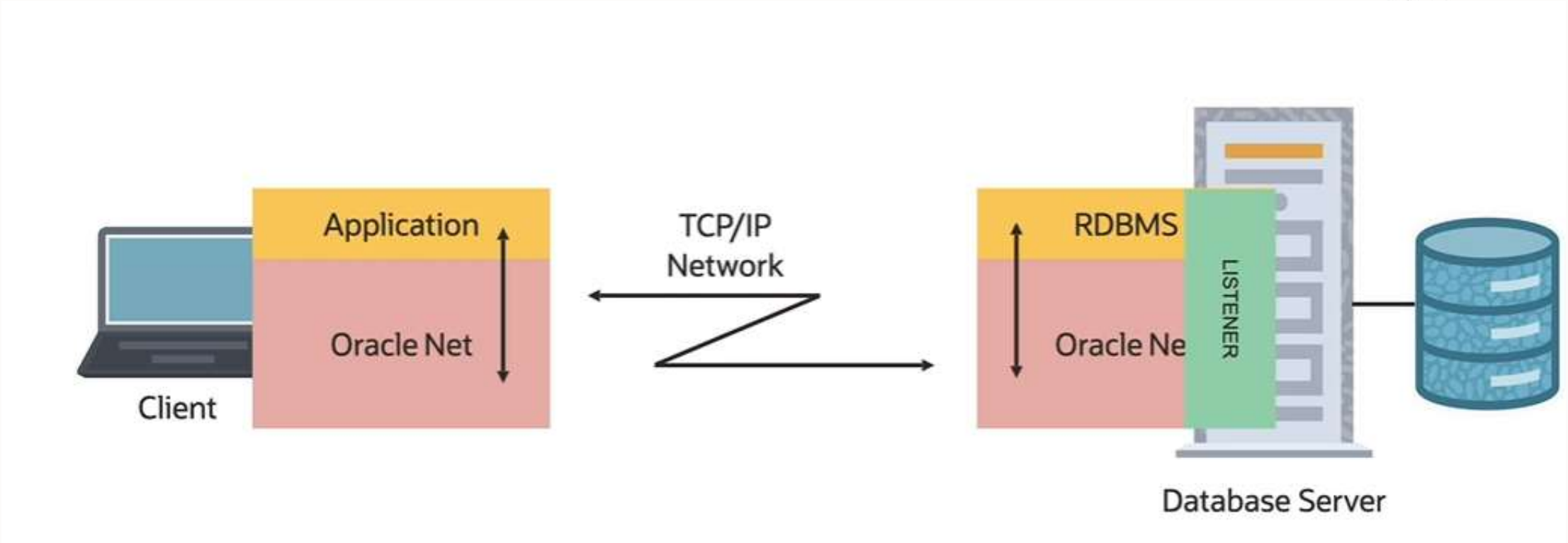
Oracle Database in Archive log mode



Oracle Database in log mode

NOARCHIVELOG mode	ARCHIVELOG mode
Closed database	Open database
Recovery to the last backup	Recovery to last committed transaction
Suitable for training and test environments, for Data Warehouses with infrequent loads	Suitable for production environments

Oracle Recovery Manager use remote connections



Recovery Manager Backup types

RMAN Repository Comparison : Control File Vs Catalog

Rman Image copies

An image copy is an **exact copy of a single data file, archived redo log file, or control file**.

They are identical to the results of copying a file with operating system commands.

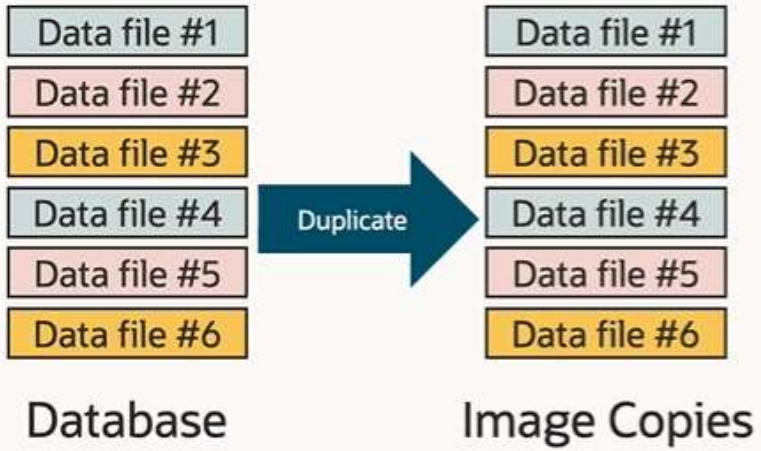
Rman Backup Sets

RMAN can store backup **data in a logical structure** called a backup set, which is the smallest unit of an RMAN backup.

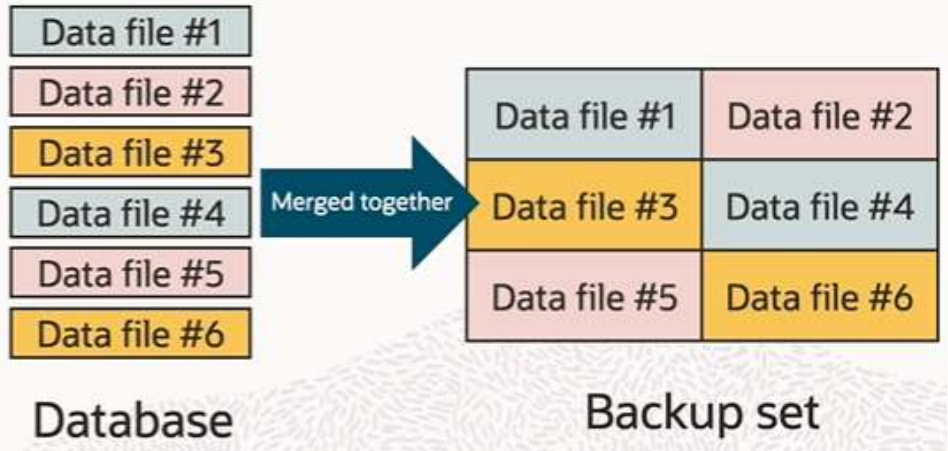
It copies just used datafile bloks instead of full files as we can see on image copies

Oracle Backup Image copies Vs Backup Set

- Image Copies



- Backup Sets



Block Change Tracking

What is Block Change Tracking feature?

- Maintain a record of block chunks that have changed since the last backup
- Whites this record to a file, as redo is generated
- Is Automatically accessed when a backup is done and can make the backup complete more quickly
- Is optimized for up to **eight incremental backups**
- Is recommended if the are **less than 20 %**
- You must to create BCK file in a **shared** file system **to all instances for Oracle Real Application Cluster (RAC)**

- **How to Manage and Evaluate the Block Change Tracking Benefits (Doc ID 2821967.1)**

APPLIES TO:

Oracle Database - Enterprise Edition - Version 12.1.0.2 and later
Information in this document applies to any platform.

PURPOSE

Help DBAs determine the benefits and impacts of Block Change Tracking (BCT).

1. Benefits of enabling BCT
2. When should customers enable BCT
3. Software recommendations and prerequisites for large busy systems
4. Configuration practices
5. Operational practices
6. Troubleshooting RMAN backups with BCT
7. Critical BCT fixed bugs

SCOPE

Intended for DBAs tuning or trying to determine the benefits of using BCT.
Intended for DBAs to determine whether they should enable BCT and what information to gather if they encounter any BCT related issues.

DETAILS

Benefits of enabling BCT

- **Block Change Tracking Inside Out** (Doc ID 1528510.1)

APPLIES TO:

Oracle Database - Enterprise Edition - Version 10.1.0.3 and later
Oracle Database Cloud Schema Service - Version N/A and later
Oracle Database Exadata Express Cloud Service - Version N/A and later
Gen 1 Exadata Cloud at Customer (Oracle Exadata Database Cloud Machine) - Version N/A and later
Oracle Database Cloud Exadata Service - Version N/A and later
Information in this document applies to any platform.

PURPOSE

Oracle RMAN was able to take incremental backups already in 9i. However, prior to introduction of Oracle 10g block change tracking (BCT), RMAN had to scan the whole datafile to and filter out the blocks that were not changed since base incremental backup and overhead or incremental backup was as high as full backup. Oracle 10g new feature, block change tracking,
minimizes number of blocks RMAN needs to read to a strict minimum. With block change tracking enabled RMAN accesses on disk only blocks that were changed since the latest base incremental backup.

This feature is widely known in the world of Oracle database administrators. However, hardly anything is available on internal implementation of block change tracking. This makes it difficult to evaluate the impact of enabling BCT in Oracle databases and quantify performance overhead.

This paper and presentation try to uncover internals of block change tracking and show which areas of Oracle database are involved, how processes work together, what are hidden limitations and impact of enabling block change tracking.

DISCLAIMER

Block Change Traking commands

- You can enable change tracking with the following statement :

```
SQL> ALTER DATABASE ENABLE BLOCK CHANGE TRACKING;
```

- Alternatively, you can specify location of block change tracking file :

```
SQL> ALTER DATABASE ENABLE BLOCK CHANGE TRACKING USING FILE '/<path>/bct.ora';
```

- To disable :

```
SQL> ALTER DATABASE DISABLE BLOCK CHANGE TRACKING;
```

- View `V$BLOCK_CHANGE_TRACKING` can be queried to find out the status of change tracking in the database.

Block Change Traking commands

```
SQL> SELECT FILENAME, STATUS, BYTES FROM V$BLOCK_CHANGE_TRACKING;
```

- Use this query to monitor **Block Change Tracking usage** :

```
SQL> SELECT FILE#, AVG(DATAFILE_BLOCKS), AVG(BLOCKS_READ),
            AVG(BLOCKS_READ/DATAFILE_BLOCKS) * 100 AS PCT_READ_FOR_BACKUP,
                      AVG(BLOCKS)
     FROM V$BACKUP_DATAFILE
         WHERE USED_CHANGE_TRACKING = 'YES'AND INCREMENTAL_LEVEL > 0
         GROUP BY FILE#;
```

• Block Change Tracking - Known Issues (Doc ID 2836206.1)

SCOPE

Software Recommendations

1. Use Database software 19.16 or above.
2. If using Database software release 19.16, apply merge patch 34872889. The merge patch contains 6 fixes for bugs 33239980 34072411 34634012 34724986 33537630 34309870.
3. If using Database software release 19.17, apply merge patch 34890438. The merge patch contains 4 fixes for bugs 33537630 34309870 34634012 34724986. The fixes for bug 33239980 34072411 already included in 19.17.
4. If using Database software release 19.18 apply patch 34902902 (base bug 34724986) and patch 34902925 (base bug 34634012).
   A merge patch is not created as these 2 bugs don't conflict, and the fixes for bug 33239980 34072411 33537630 34309870 already included in 19.18.
5. If using BFT (Big File Tablespace), install patch 35013485

DETAILS

The following is a list of some of the known issues with block change tracking (BCT):

You can restrict the list below to issues likely to affect one of the following versions by clicking the relevant button:

21.13 | 21.12 | 21.11 | 21.10 | 21.9 | 21.8 | 21.7 | 21.6 | 19.22 | 19.21 | 19.20 | 19.19 | 19.18 | 19.17 | 19.16 | 19.15 | 19.14
19.13 | 19.12 | 19.11 | 19.10 | 19.9 | 19.8 | 19.7 | 19.6 | 19.5 | 19.4 | 19.3 | 19.2 | 19.1 | 18.13 | 18.12 | 18.11 | 18.10 | 18.9
18.8 | 18.7 | 18.6 | 18.5 | 18.4 | 18.3 | 18.2 | 18.1 | 12.2.0.1 | 12.1.0.2 | 12.1.0.1 | 11.2.0.4 | 11.2.0.3 | 11.2.0.2 | 11.2.0.1
11.1.0.7 | 11.1.0.6 | 10.2.0.5 | 10.2.0.4 | 10.2.0.3 | 10.2.0.2 | 10.1.0.5 | 9.2.0.8 | Show all Bugs

Configuring Recovery Manager

Configuring Persistent Settings for RMAN

1. **RMAN** is preset with default configurations settings for any new and current job

2. Use the **CONFIGURE** command to :

   2.1 Configure automatic channels
   2.2 Specify the backup retention policy
   2.3 Specify the number of backup copies to be created
   2.4 Set the default backup type to BACKUPSET or COPY
   2.5 Limit the size of backup pieces
   2.6 Exemp a tablespace from backup
   2.7 Enable and disable backup optimization
   2.8 Configure automatic backup of control file
   2.9 Define the archive log deletion policy
   2.10 Specify the parallelism for a device
   2.11 Set the encryption and compression parameters to be used for backup

Recovery Manager persistent settings

```
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RMAN> show all;

using target database control file instead of recovery catalog
RMAN configuration parameters for database with db_unique_name PROD are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
CONFIGURE BACKUP OPTIMIZATION OFF; # default
CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP ON; # default
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO '%F'; # default
CONFIGURE DEVICE TYPE DISK PARALLELISM 1 BACKUP TYPE TO BACKUPSET; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE ENCRYPTION FOR DATABASE OFF; # default
CONFIGURE ENCRYPTION ALGORITHM 'AES128'; # default
CONFIGURE COMPRESSION ALGORITHM 'BASIC' AS OF RELEASE 'DEFAULT' OPTIMIZE FOR LOAD TRUE ; # default
CONFIGURE RMAN OUTPUT TO KEEP FOR 7 DAYS; # default
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO '/opt/oracle/product/19c/dbhome_1/dbs/snapcf_PROD.f'; # default
```

Changing Recovery Manager persistent settings

```
Recovery Manager: Release 19.0.0.0.0 - Production on Tue Feb 27 16:26:23 2024
Version 19.3.0.0.0

connected to target database: PROD (DBID=573823810)

RMAN> CONFIGURE CONTROLFILE AUTOBACKUP OFF;

using target database control file instead of recovery catalog
old RMAN configuration parameters:
CONFIGURE CONTROLFILE AUTOBACKUP ON;
new RMAN configuration parameters:
CONFIGURE CONTROLFILE AUTOBACKUP OFF;
new RMAN configuration parameters are successfully stored


RMAN> CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE TAPE TO '%F';

new RMAN configuration parameters:
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE 'TAPE' TO '%F';
new RMAN configuration parameters are successfully stored
```

Fixing Rman configuration on channel Allocations

- Sample 1 – Device Type on channel

```
RUN
{
  ALLOCATE CHANNEL t1 DEVICE TYPE sbt PARMS 'ENV=(OB_DEVICE_1=stape1,OB_DEVICE_2=stape3)';
  ALLOCATE CHANNEL t2 DEVICE TYPE sbt PARMS 'ENV=(OB_DEVICE_1=stape2,OB_DEVICE_2=stape4)';
  SET COMPRESSION ALGORITHM 'HIGH';
  SET BACKUP COPIES 2;
  BACKUP DATABASE;
}
```

Fixing Rman configuration on channel Allocations

- Sample 2 – Set compression level on channel

```
RUN
{
  ALLOCATE CHANNEL t1 DEVICE TYPE sbt PARMS 'ENV=(OB_DEVICE_1=stape1,OB_DEVICE_2=stape3)';
  ALLOCATE CHANNEL t2 DEVICE TYPE sbt PARMS 'ENV=(OB_DEVICE_1=stape2,OB_DEVICE_2=stape4)';
  SET COMPRESSION ALGORITHM 'HIGH';
  SET BACKUP COPIES 2;
  BACKUP DATABASE;
}
```

Fixing Rman configuration on channel allocations

- Sample 3 – Set database parameter file on channel

```
RUN
{
  ALLOCATE AUXILIARY CHANNEL c1 DEVICE TYPE sbt;
  DUPLICATE TARGET DATABASE
    TO dupdb
  DB_FILE_NAME_CONVERT '/disk2/dbs/','/disk1/'
  SPFILE PARAMETER_VALUE_CONVERT   '/disk2/dbs/', '/disk1/'
  SET LOG_FILE_NAME_CONVERT '/disk2/dbs/','/disk1/';
}
```

Recovery Manager Features

Recovery Manager Compression backups

Rman can perform binary compression on any backup set that is generated

- It can be performed in addiction to unused block compression
- Available compression algorithms are `HIGH/MEDIUM/LOW/BASIC`
- No extra steps are required by the DBA to restore a compressed backup

```
RMAN> CONFIGURE COMPRESSION ALGORITHM 'HIGH/MEDIUM/LOW/BASIC'
;

RMAN> Run
{
SET COMPRESSION ALGORITHM 'HIGH/MEDIUM/LOW/BASIC';
...}
```

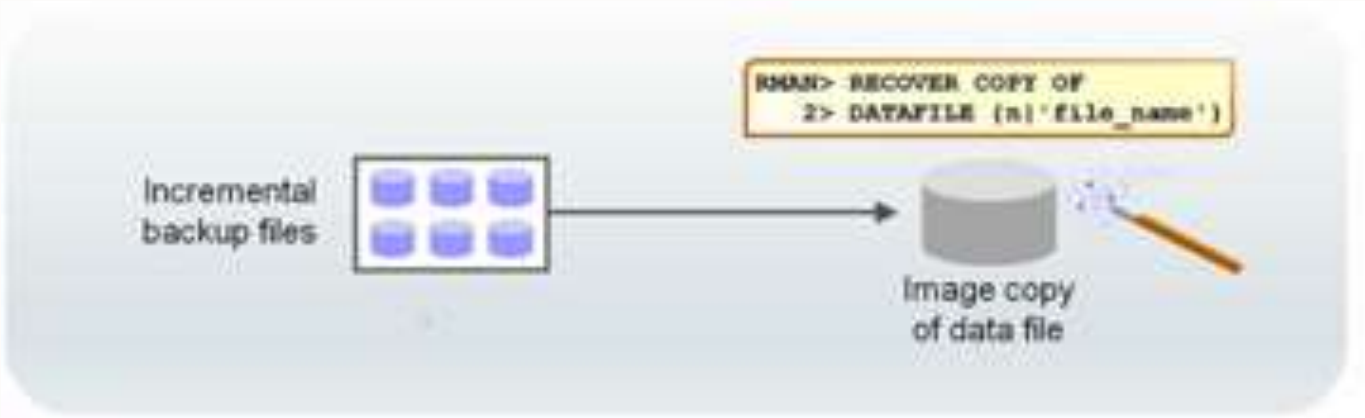
```
RMAN> BACKUP AS COMPRESSED BACKUPSET DATABASE PLUS ARCHIVELOG;
```

Using Rman Backup Compression

Compression Ratio or Level	Considerations	Requires Advanced Compression Option
LOW	Fastest. Best suited to address backup: CPU resources.	✓
MEDIUM	Fast. Good balance of CPU usage and compression ratio.	✓
HIGH	Best compression ratio at the expense of high CPU consumption. Best suited to address backup constraint: network.	✓
BASIC	Fair. Compression ratio similar to MEDIUM at expense of additional CPU usage. Compression ratio between MEDIUM and HIGH.	

RMAN Incrementally Updated Backups

- Image Copies are updated with all changes up to the incremental backup SCN
- Incremental backup reduces the time required for mediarecovery
- With incrementally updated backups, you can use the `SWITCH` command during the recovery operation



Using incremental backups to image copies command

```
RMAN> BACKUP INCREMENTAL LEVEL 0 AS COPY DATABASE TAG 'BackupFull';

RMAN> BACKUP INCREMENTAL LEVEL 1 FOR RECOVER OF COPY WITH TAG 'BackupFull' DATABASE;

RMAN> RECOVER COPY OF DATABASE WITH TAG 'BackupFull';
```

Tuning Recovery Manager

Recovery Manager Backup Process Steps an fases ?

1
Read Phase

A channel reads clocks from disk into input I/O buffers.

2
Copy Phase

A channel copies blocks from input buffers to output buffers and performs additional processing on the blocks.

3
White Phase

A channel writes the blocks from output buffers to storage media. depending on the type of backup media: write phase for System Backup Tape / write phase for disk.

Using Views to diagnose RMAN Performance Problems

```
SQL> $DESC SESSION_LONGOPS
```

Name	Descriptions
SID	The server session ID corresponding to an RMAN channel
SERIAL#	The server session serial number. This value changes each time a server session is reused.
OPNAME	A text description of the row. Examples : RMAN: datafile copy, RMAN: full datafile backup
SOFAR	The meaning of this column depends on the type of operation to finish
TOTALWORK	The meaning of this column depends on the type of operation already concluded
UNITS	
START_TIME	
LAST_UPDATE_TIME	
TIMESTAMP	
TIME_REMAINING	
ELAPSED_SECONDS	
CONTEXT	For backup output rows, value is 2. Other rows, value is 1,

Thanking Recovery Manager Backup Process Steps

```
SQL> SELECT SID, SERIAL#, CONTEXT, SOFAR, TOTALWORK,
       ROUND(SOFAR/TOTALWORK*100,2) "%_COMPLETE"
FROM   V$SESSION_LONGOPS
WHERE  OPNAME LIKE 'RMAN%'
AND    OPNAME NOT LIKE '%aggregate%'
AND    TOTALWORK != 0
AND    SOFAR <> TOTALWORK;
```

Performance views can help to find the issue

View	Use
V$SESSION_LONGOPS	Monitoring the progress of backups and restore jobs
V$BACKUP_SYNC_IO	Identifying bottlenecks Determining whether the tape is streaming when the I/O is synchronous Viewing detailed progress of backup jobs
V$BACKUP_ASYNC_IO	Identifying bottlenecks Determining the rate of asynchronous I/O

Oracle Recovery Manager Catalog

RMAN Repository Comparison : Control File Vs Catalog

Control File

- Simpler administration
- Default configurations
- Use parameter `control_file_record_keep_time = 7 (Day number retention)`

Recovery Catalog

- Replicates Control file data
- Stores more backup history
- Services man Targets
- Stores Rman scripts
- Provides more options for metadata (keep Forever)

What is a Virtual private Catalog ?

The virtual private catalog was introduced in Oracle 11g. This new feature lets you grant restricted access on RMAN Catalog to some users so that they can access a limited set of application databases that are registered in the recovery catalog. To enable this feature you must complete steps bellow :

- Create the recovery catalog owner.
- Create the owner of the Virtual private catalog (VPC).
- Gran create session to VPC owner
- In RMAN as the catalog owner, create the catalog
- In SQL*plus, as sysdba, execute dbmsrmanvpc.sql to enable VPD
- In Rman, as the catalog owner, connect to catalog and upgrade the catalog
- Grant privileges (access to the metadata/ability to register new target databases) to VPC owner.

RMAN Catalog Scripts

Why create a script for Oracle RMAN commands ?

There are two primary reasons:

- Most Oracle RMAN activities are batch-oriented and can be automated. For instance, **backing up a database is a repetitive activity** and not something you would want to **execute interactively**.

- **Scripts provide consistency**. For tasks of an ad hoc nature, such as recovering a database from a backup, automation is not strictly required. When a script is used to execute the activity, however, the action will be the same, **regardless** of the experience and **expertise of the D**BA performing the recovery.

There are two ways to script Oracle RMAN commands in Oracle Database

Command Files

Use a command file. A command file is a text file residing in the file system.

The file **extension .rman is not necessary**, but it is helpful in making the meaning of the file clear.

Stored Scripts

Use a stored script. This script is stored in the Oracle RMAN catalog database and executed from the Oracle RMAN command prompt.

To execute this script, all you have to do is call it with the execute command from the Oracle RMAN prompt

Oracle RMAN Scripting command files samples

1. RMAN prompt, you can call the example command. using the extension ***(.rman***).

2. You can also call the command file directly from the command line. This approach for calling the script

3. Also note that instead of using the @ sign to call the command file, you can use the ***cmdfile*** parameter.

4. You can create Global Scripts to be available in all Database

1. **RMAN>** @backup_ts_users.rman

2. **rman** @backup_ts_users.rman

3. rman **cmdfile**=backup_ts_users.rman

4. rman **create [GLOBAL] script script_name**

Rman Backup for Oracle RAC

- **RMAN: RAC Backup, Restore and Recovery using RMAN** (Doc ID 243760.1)

APPLIES TO:

Oracle Database - Standard Edition
Oracle Database - Personal Edition
Oracle Database - Enterprise Edition - Version 11.2.0.3 and later
Oracle Database Cloud Schema Service - Version N/A and later
Oracle Database Exadata Cloud Machine - Version N/A and later
Information in this document applies to any platform. *** ***
Checked for relevance on 24-Jan-2018

PURPOSE

The purpose of this document is to give a quick guide for using RMAN on RAC databases. We will follow this points:

1. Verify the database mode and archive destination.
2. Verify connectivity using sqlnet for target and catalog.
3. Determine the backup device.
4. Understand how to create an RMAN persistent configuration for a RAC env.
5. Create backups to disk using the new persistent configuration parameters.
6. Backupset maintenance using the configured retention policy.
7. Restore and Recover
   a. Complete
   b. Incomplete
8. Review and understand the impact of resetlogs on the catalog.
9. RMAN Sample Commands.

SCOPE

- This discussion is for a 2-node Oracle RAC Cluster.
- The logs are being archived to their respective node.
- We are allocating channels to each node to enable the autolocate feature of RMAN in a RAC env

Troubleshooting Recovery Manager

SRDC - Required Diagnostic Data Collection for RMAN Issues (Doc ID 1671431.1)

What is being collected and why?

Information needed to begin diagnosis of RMAN issues.

Action Plan

1. Reproduce the error/issue with debugging enabled as follows:

a. set the nls_date_format environment variable:
For Unix: $ export NLS_DATE_FORMAT='DD-MON-YYYY HH24MISS'
For Windows: SET NLS_DATE_FORMAT='DD-MON-YYYY HH24MISS'
b. Invoke rman with: **$ rman debug all trace=srdc_rman_debug_<date>.trc log=srdc_rman_output_<date>.log**
c. Execute

```
connect target /;
connect catalog ..... /* if rman catalog is being used */
set echo on;
<Command to reproduce the issue>
exit
```

NOTE: If you are unable to execute the command in debug, provide the RMAN output. However, one may be required by the analyst after initial diagnosis.

2. Download and install the latest version of TFA using the AHF installer: Download AHF

3. As the RDBMS / DB homeowner, run the TFA collection using the following command:

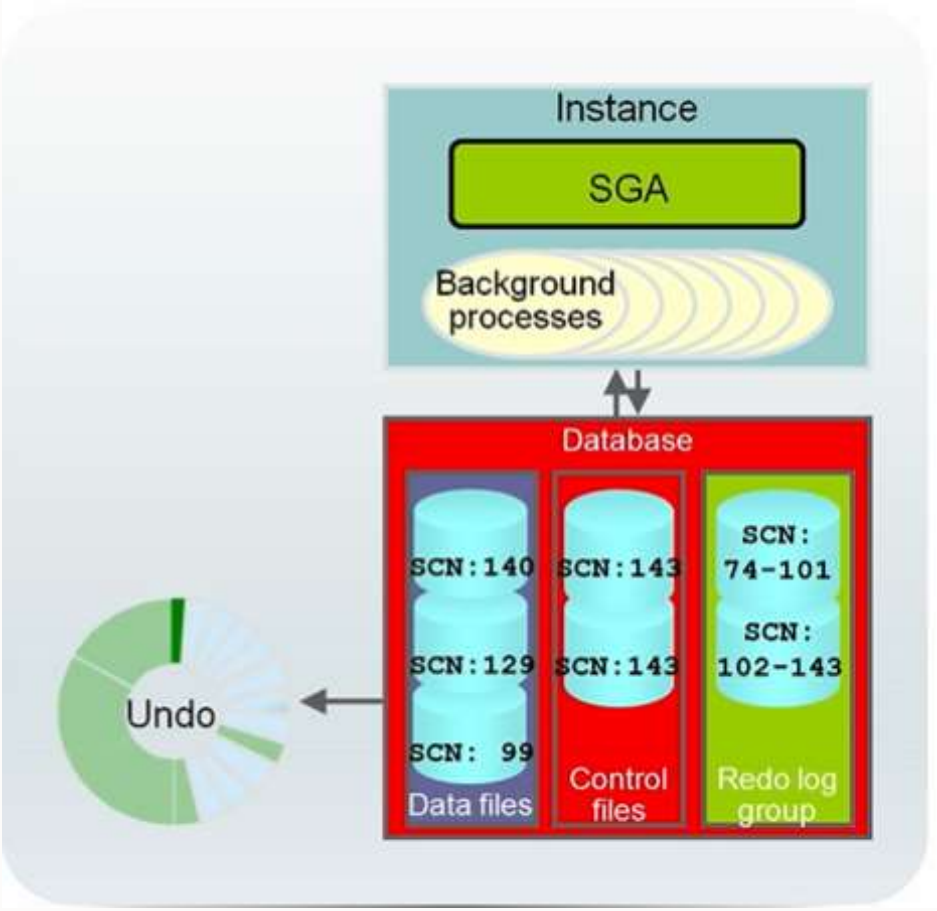
```
$tfactl diagcollect -srdc dbrman
```

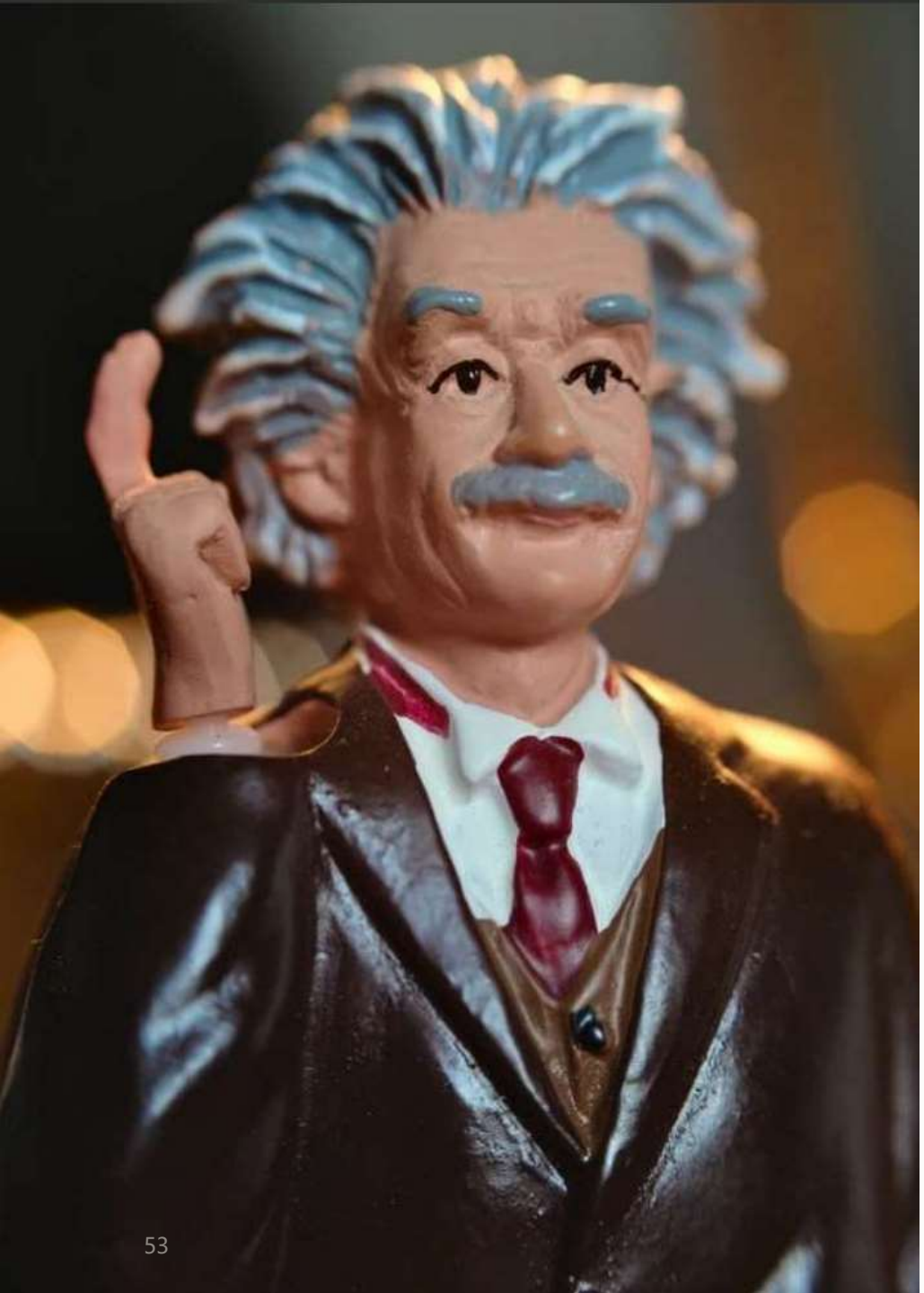
4. Upload the resulting zip file *exactly as it is generated* to the Service Request (SR)

Oracle Recovery Manager Restore

Phases of Oracle Database instance Recovery

1. Instance startup (Data Files are out of sync)
2. Roll forward (redo)
3. Committed and uncommitted data in files
4. Database opened
5. Roll back (Undo)
6. Committed data in files





Demo 1 – Oracle Tracking Trace File

- Enabling Oracle Tracing Trace file
- Compare incremental backup Time

Demo 2 – Oracle Database Catalog

- Create a recovery catalog
- Register a Database on recovery Catalog
- Unregister database from Recovery Catalog
- Drop Catalog from recovery database

Demo 3 – Catalog Database Scripts

- Create catalog scripts
- Change catalog Scripts
- Execute Catalog Scripts
- Drop Catalog from recovery database

Resources

- **Oracle Database 19c Backup and Recovery (University Course)**

  https://mylearn.oracle.com/ou/course/oracle-database-19c-backup-and-recovery/77517/76724

- **Oracle Database 19c Datagard Administration (University Course)**

  https://mylearn.oracle.com/ou/course/oracle-database-19c-data-guard-administration-workshop/116186/

- **Oracle Database 19c Administration (University Course)**

  https://mylearn.oracle.com/ou/learning-path/oracle-database-19c-administration/86069

- **Oracle Database 19c Backup and Recovery user guide**

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Thank you

Marcel Lamarca
marcel.lamarca@oracle.com


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