



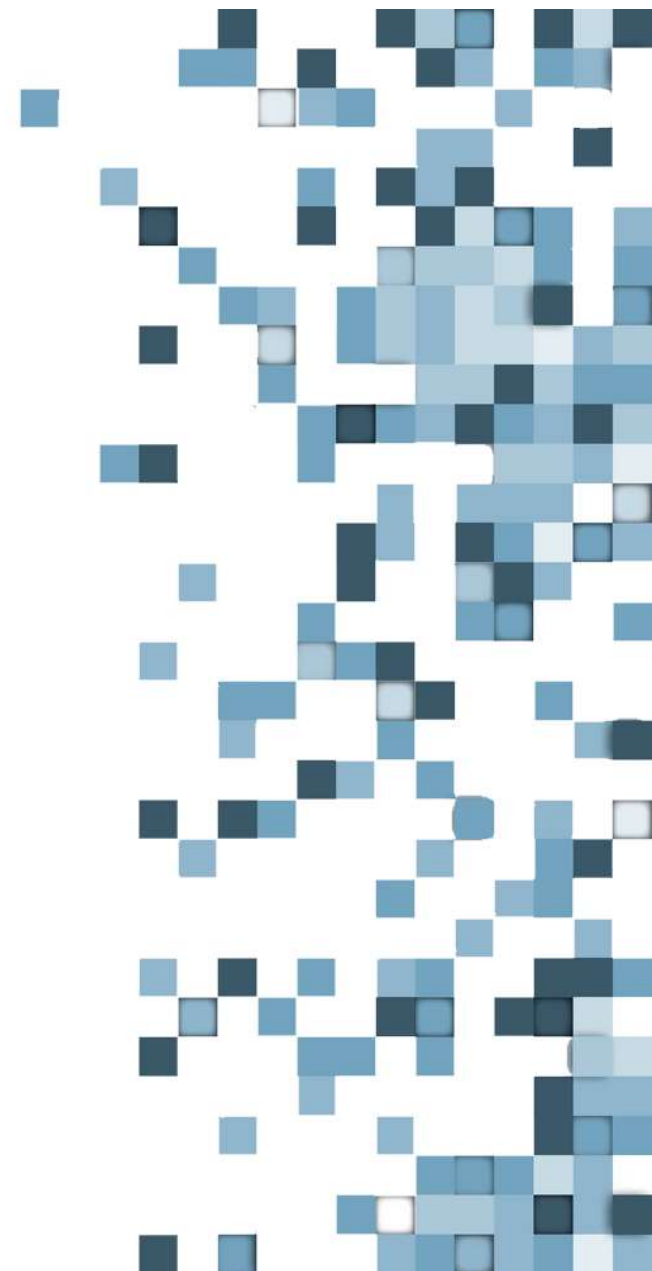
# ZDLRA, What it is? Is it worth it?

HrOUG 2021

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Oracle ACE ♠



## SAFE HARBOR STATEMENT

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- *“The postings on this document are my own and don’t necessarily represent my actual employer positions, strategies or opinions. The information here was edited to be useful for general purpose, specific data and identifications were removed to allow reach the generic audience and to be useful for the community.”*

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# AGENDA

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- Who I am and what I will be talking about.
- Backup, Recovery, and Availability.
- What is ZDLRA.
- ZDLRA: Enrolling and Protecting the database.
- ZDLRA: Internals.
- QA.

# ABOUT ME

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- Senior Database Specialist at Luxembourg.
  - OCP, OCE RAC, OCI Architect, Autonomous Specialist.
- Oracle ACE ♠ , OOW, OOWLA, and User Groups speaker/presentations.
- Contacts:  
[fernando.simon.br@gmail.com](mailto:fernando.simon.br@gmail.com)

<https://www.fernandosimon.com/blog/>

<https://twitter.com/FSimonDBA>

<https://www.linkedin.com/in/fernando-simon/>



# ABOUT ME

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- DBA since 2004:
  - Oracle, PostgreSQL, SQLServer, and DB2.
- Head and DBA Team Manager at Court of Justice:
  - Exadata since 2010.
  - ZDLRA since 2014/2015:
    - [ZDLRA Use Case for MAA Project, RAC+RAC, DG, ZDLRA.](#)
- Contributing with Oracle Brazil Community since 2010.
- Luxembourg October/2017.
- Consulting at European Commission:
  - LCM (Life Cycle Management) to the Oracle Products.
- Consulting at Bank Institution:
  - DBA Architect, MAA Infrastructure, ExaCC/Exadata and ZDLRA support.
- LUXOUG Co-Founder and Board Member.

## SESSION

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- How is your protection today?
  - How much **time** my backups needs to complete?
  - What is the load over the environment to do the backups?
  
  - What happens if you need to recover your database?
  - What is my **data loss** in the case of an outage?
  - What's happens if I lost my storage?
  
  - What is my **protection** today?
  - Do I know what I need to cover? What are the **regulations**?
  - My secondary site has the same protection as the primary?

# BACKUP, RECOVERY, AND AVAILABILITY

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- Real Life:
  - Data Loss (usually since the last backup).
  - **Huge impact** on the environment (Backup Window).
  - A lot of players (Tivoli, EMC, Commvault).
  - Cloud backups and clones.
  - Redundancy over redundancy over redundancy...
  - Endless Validation, test, validation, test...
- Questions that we face:
  - Where are my backups?
  - Lost data?
  - How they are and can I restore them?
  - Where are the tapes?
  - Which backups do I need?



## BACKUP, RECOVERY, AND AVAILABILITY

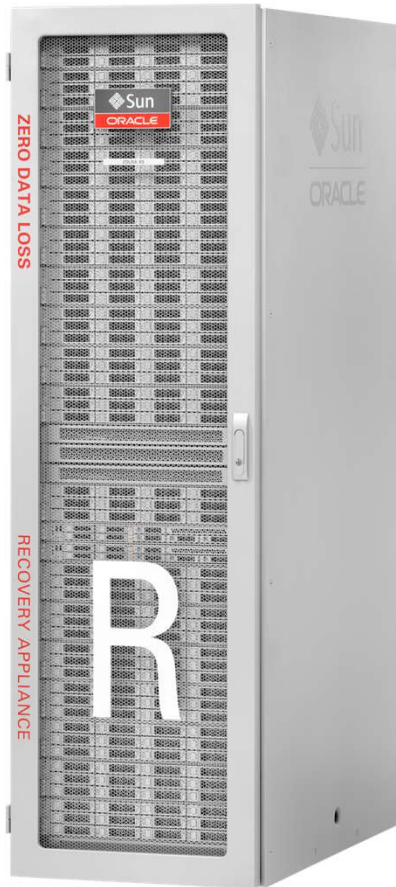
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- Schrödinger's Cat Backup Paradox:

“The condition of any backup is unknown until a restore is attempted”



And it is worst...



# WHAT IS ZDLRA

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- What is the **Zero Data Loss Recovery Appliance (ZDLRA)**?
  - What did you hear about it?
  - Just backup?
  - Backup Appliance?
  - Incremental forever strategy?
  - Deduplication?

# WHAT IS ZDLRA

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- **ZERO DATA LOSS RECOVERY APPLIANCE – ZDLRA:**

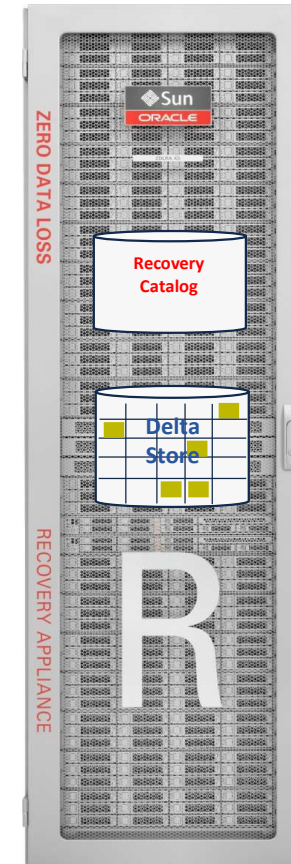
- Engineered Systems.
- Exadata based.
- Hardware + Software:
  - RA Library.
- Media Management Layer (MML) for tape.
- Native replication.
- RMAN Catalog.
- Can be used to protect ExaCC.

- **DOES NOT REDUCES RTO, JUST RPO.**

# ZDLRA – INSIDE APPLIANCE

---

- Oracle Database:
  - Store the backups/archivelogs **plus** configuration metadata:
    - Backup Policies and Database definitions.
    - **Delta Store**, Packages, **tasks**, and operations.
  - Rman catalog:
    - Self-driven catalog: **No more crosscheck and validations.**
- EM/CC/CLI:
  - DBMS\_RA package to manage everything.
- Backup library **is installed** in every server that will backup.
  - From Oracle 10g to 19c, RISC and CISC, AIX, Win, Linux, Solaris...



## ZDLRA – DELTA STORE

---

- Delta Store:
  - Store Oracle Data Blocks from datafiles.
  - **Delta Push** = Ingested Backups + Real-Time Redo Transport.
  - Oracle Data Block validation during all backup/data life-cycle:
    - Validated during the backup ingestion, **rebuild**, replication, and clones (tape and cloud).
  - Tasks to sustain everything:
    - Automatic backup index, management, and validation.

# ZDLRA – VIRTUAL FULL BACKUP

---

- Virtual Full Backup:

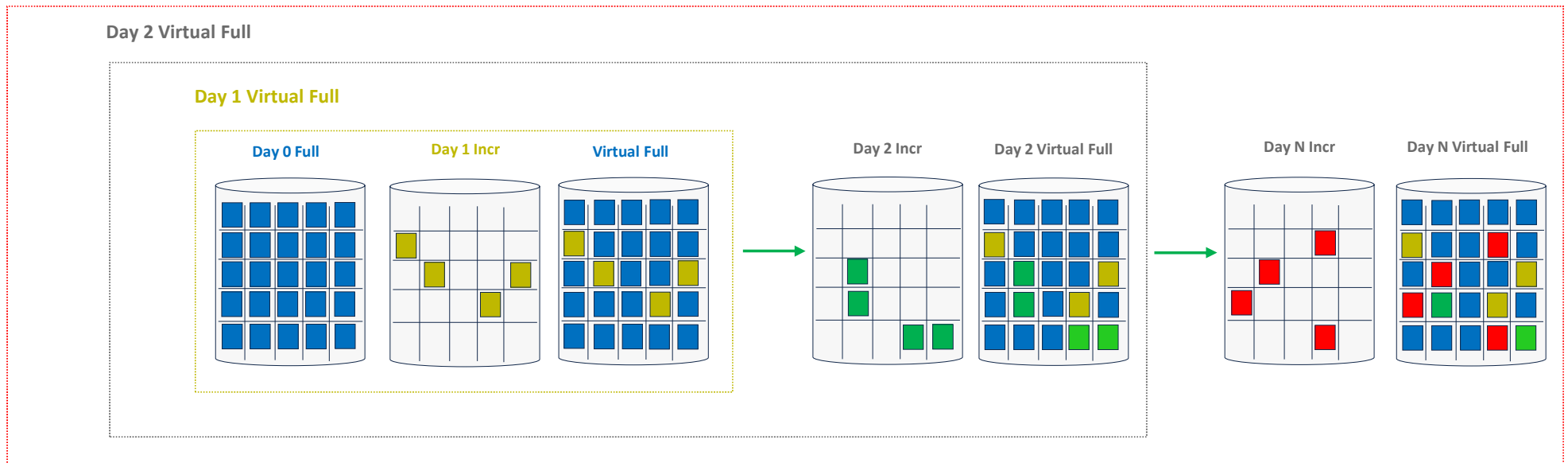
- Ingested RMAN backup sets are **deconstructed** and **reconstructed** at data block level.
- Generate an index for every datafile.
  - Create a matrix (plan of blocks) for every datafile.
- Differs from deduplication:
  - **Content aware.**
  - Opens backupset and **natively** “see” each data block.

- **Incremental Forever Strategy:**

- Initial level 0 backup + consequent level 1 backups.
  - ZDLRA merge both and generate the virtual full backup.
- Changes nothing at the RMAN side. Backup and restore commands continue the same.

# ZDLRA – VIRTUAL FULL BACKUP

## Day N Virtual Full





```
RMAN> list backup of datafile 1;
```

```
List of Backup Sets
```

```
=====
```

| BS Key   | Type | LV   | Size    | Device   | Type                | Elapsed Time | Completion Time                              |
|--|------|------|---------|----------|---------------------|--------------|--|
| 14406  | Incr | 0    | 330.29M | SBT_TAPE |                     | 00:03:16     | 05/01/2020 17:40:31                          |
| BP Key: 14407 Status: AVAILABLE Compressed: YES Tag: BKP-DB-INC0 |      |      |         |          |                     |              |  |
| Handle: VB\$_1891149551_14397I Media:                            |      |      |         |          |                     |              |  |
| List of Datafiles in backup set 14406                            |      |      |         |          |                     |              |  |
| File   | LV   | Type | Ckp     | SCN      | Ckp Time            | Abs Fuz      | SCN Sparse Name                              |
| 1  | 0    | Incr | 1885317 |          | 05/01/2020 17:37:15 | NO           | /u01/app/oracle/oradata/ORCL18C/system01.dbf |

| BS Key  | Type | LV   | Size    | Device   | Type                | Elapsed Time | Completion Time                              |
|---|------|------|---------|----------|---------------------|--------------|--|
| 14431   | Incr | 1    | 56.00K  | SBT_TAPE |                     | 00:00:02     | 05/01/2020 17:44:24                          |
| BP Key: 14432 Status: AVAILABLE Compressed: YES Tag: BKP-DB |      |      |         |          |                     |              |  |
| Handle: VB\$_1891149551_14430I Media:                       |      |      |         |          |                     |              |  |
| List of Datafiles in backup set 14431                       |      |      |         |          |                     |              |  |
| File  | LV   | Type | Ckp     | SCN      | Ckp Time            | Abs Fuz      | SCN Sparse Name                              |
| 1   | 1    | Incr | 1885774 |          | 05/01/2020 17:44:22 | NO           | /u01/app/oracle/oradata/ORCL18C/system01.dbf |

| BS Key  | Type | LV   | Size    | Device   | Type                | Elapsed Time | Completion Time                              |
|---|------|------|---------|----------|---------------------|--------------|--|
| 14435   | Incr | 0    | 329.18M | SBT_TAPE |                     | 00:00:02     | 05/01/2020 17:44:24                          |
| BP Key: 14436 Status: AVAILABLE Compressed: YES Tag: BKP-DB |      |      |         |          |                     |              |  |
| Handle: VB\$_1891149551_14430_1 Media:                      |      |      |         |          |                     |              |  |
| List of Datafiles in backup set 14435                       |      |      |         |          |                     |              |  |
| File  | LV   | Type | Ckp     | SCN      | Ckp Time            | Abs Fuz      | SCN Sparse Name                              |
| 1   | 0    | Incr | 1885774 |          | 05/01/2020 17:44:22 | NO           | /u01/app/oracle/oradata/ORCL18C/system01.dbf |

```
RMAN>
```

MERGED

```

RMAN> list backup of datafile 414 completed after "sysdate - 2";

List of Backup Sets
=====

BS Key Type LV Size Device Type Elapsed Time Completion Time
-----
414182678 Incr 1 4.72G SBT_TAPE 00:08:19 02/11/2020 01:09:58
BP Key: 414182679 Status: AVAILABLE Compressed: YES Tag: BKP-DB
Handle: VB$_4025171673_414166781I Media:
List of Datafiles in backup set 414182678
File LV Type Ckp SCN Ckp Time Name
-----
414 1 Incr 5679540841750 02/11/2020 01:01:39 +DATA6/opg5/datafile/tsdigimlong_pmax.267.954009149

BS Key Type LV Size Device Type Elapsed Time Completion Time
-----
414186971 Incr 0 24.28T SBT_TAPE 00:08:19 02/11/2020 01:09:58
BP Key: 414186972 Status: AVAILABLE Compressed: YES Tag: BKP-DB
Handle: VB$_4025171673_414166781_414 Media:
List of Datafiles in backup set 414186971
File LV Type Ckp SCN Ckp Time Name
-----
414 0 Incr 5679540841750 02/11/2020 01:01:39 +DATA6/opg5/datafile/tsdigimlong_pmax.267.954009149

BS Key Type LV Size Device Type Elapsed Time Completion Time
-----
414232984 Incr 1 2.52G SBT_TAPE 00:16:42 03/11/2020 01:19:00
BP Key: 414232985 Status: AVAILABLE Compressed: YES Tag: BKP-DB
Handle: VB$_4025171673_414218563I Media:
List of Datafiles in backup set 414232984
File LV Type Ckp SCN Ckp Time Name
-----
414 1 Incr 5679737301521 03/11/2020 01:05:02 +DATA6/opg5/datafile/tsdigimlong_pmax.267.954009149

BS Key Type LV Size Device Type Elapsed Time Completion Time
-----
414240294 Incr 0 24.28T SBT_TAPE 00:16:42 03/11/2020 01:19:00
BP Key: 414240295 Status: AVAILABLE Compressed: YES Tag: BKP-DB
Handle: VB$_4025171673_414218563_414 Media:
List of Datafiles in backup set 414240294
File LV Type Ckp SCN Ckp Time Name
-----
414 0 Incr 5679737301521 03/11/2020 01:05:02 +DATA6/opg5/datafile/tsdigimlong_pmax.267.954009149

RMAN>

```

## ZDLRA – CLONE TO TAPE

---

- Tape and Cloud:
  - Can copy to tapes directly, is MML:
    - It can be by OSB or third-party (if it is compatible with rman).
    - Natively uses Oracle Secure Backup (OSB) with SAN.
  - Can copy backups to Oracle Cloud, Object Store.
  - **Requires schedule.** Based on dbms\_scheduler for the clone job.
  - Can be based on several metadata information:
    - RMAN Tag, Date, Backup Types...

# ZDLRA – CLONE TO TAPE

```
RMAN> list backupset 12631;

List of Backup Sets
=====

BS Key  Type LV Size
-----  -
12631   Incr 0  336.35M
List of Datafiles in backup set 12631
File LV Type Ckp SCN    Ckp Time          Abs Fuz SCN Sparse Name
-----  -
1       0   Incr 2452316  01/01/2020 20:25:20          NO      +DATA/OR19DG/DATAFILE/system.265.1028557261

Backup Set Copy #1 of backup set 12631
Device Type Elapsed Time Completion Time    Compressed Tag
-----  -
SBT_TAPE    01:50:05    01/01/2020 20:25:23 YES          BKP-DB

List of Backup Pieces for backup set 12631 Copy #1
BP Key  Pc# Status      Media              Piece Name
-----  -
12632   1   AVAILABLE    VB$ _1891149551_12626_1

Backup Set Copy #2 of backup set 12631
Device Type Elapsed Time Completion Time    Compressed Tag
-----  -
SBT_TAPE    01:50:05    01/01/2020 22:15:25 NO          BKP-DB

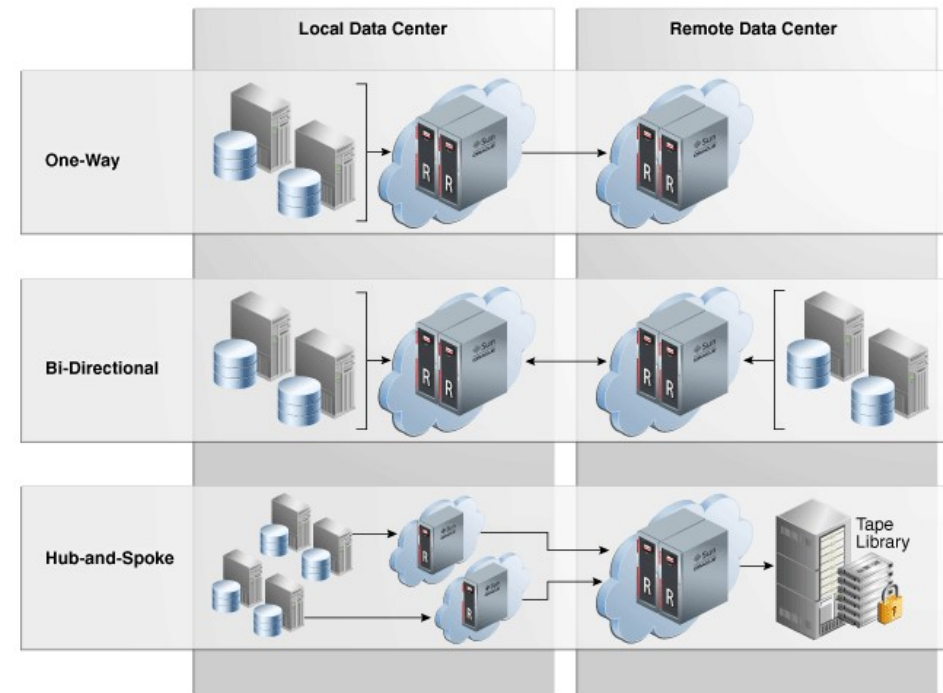
List of Backup Pieces for backup set 12631 Copy #2
BP Key  Pc# Status      Media              Piece Name
-----  -
13361   1   AVAILABLE    zdlras1-osbmf-000001  RA_SBT_OR19DG_41954437_13318_qsuktng_1_2_12631

RMAN>
```

# ZDLRA - REPLICATION

---

- Replication:
  - One-Way:
    - One master and one destination.
  - Bi-Directional:
    - Both sides replicate each other.
  - Hub/Spoke:
    - One to many.
  - Executed automatically, as soon as possible.



# ZDLRA – REAL-TIME REDO TRANSPORT

---

- Real-Time Redo Transport:
  - Is the “zero data loss” - guarantee the zero RPO:
    - Reduces RPO from the last backup to zero/sub-seconds.
  - Is simple. ZDLRA it is a log\_archive\_dest destination:
    - Uses same procedure than Data Guard. ZDLRA operates with RFS to receive redo buffers (SYNC/ASYNC).

```
SQL> select value from v$parameter where name = 'log_archive_dest_2';  
  
VALUE  
-----  
SERVICE="zdlras1-scan:1521/zdlras1:VPCSRC" SYNC NOAFFIRM DB_UNIQUE_NAME=zdlras1 VALID_FOR=(ONLINE_LOGFILE,ALL_ROLES)  
  
SQL>
```

- If protected database crash, ZDLRA creates *'partial archived log backup'* with last sent redo info.
- **DOES NOT REQUIRE DG LICENSE! INDEPENDENTLY OF ORACLE EDITION THAT YOU USE!**

# ZDLRA – REAL-TIME REDO TRANSPORT

```

RMAN> list copy of archivelog all;

List of Archived Log Copies for database with db_unique_name OR19DG
=====

Key       Thrd Seq      S Low Time
-----
13295    1      90      A 01/01/2020 22:28:18
        Name: +RECO/OR19DG/ARCHIVELOG/2020_01_01/thread_1_seq_90.446.1028586681

RMAN> alter system archive log current;

Statement processed

RMAN> list backup of archivelog sequence 91;

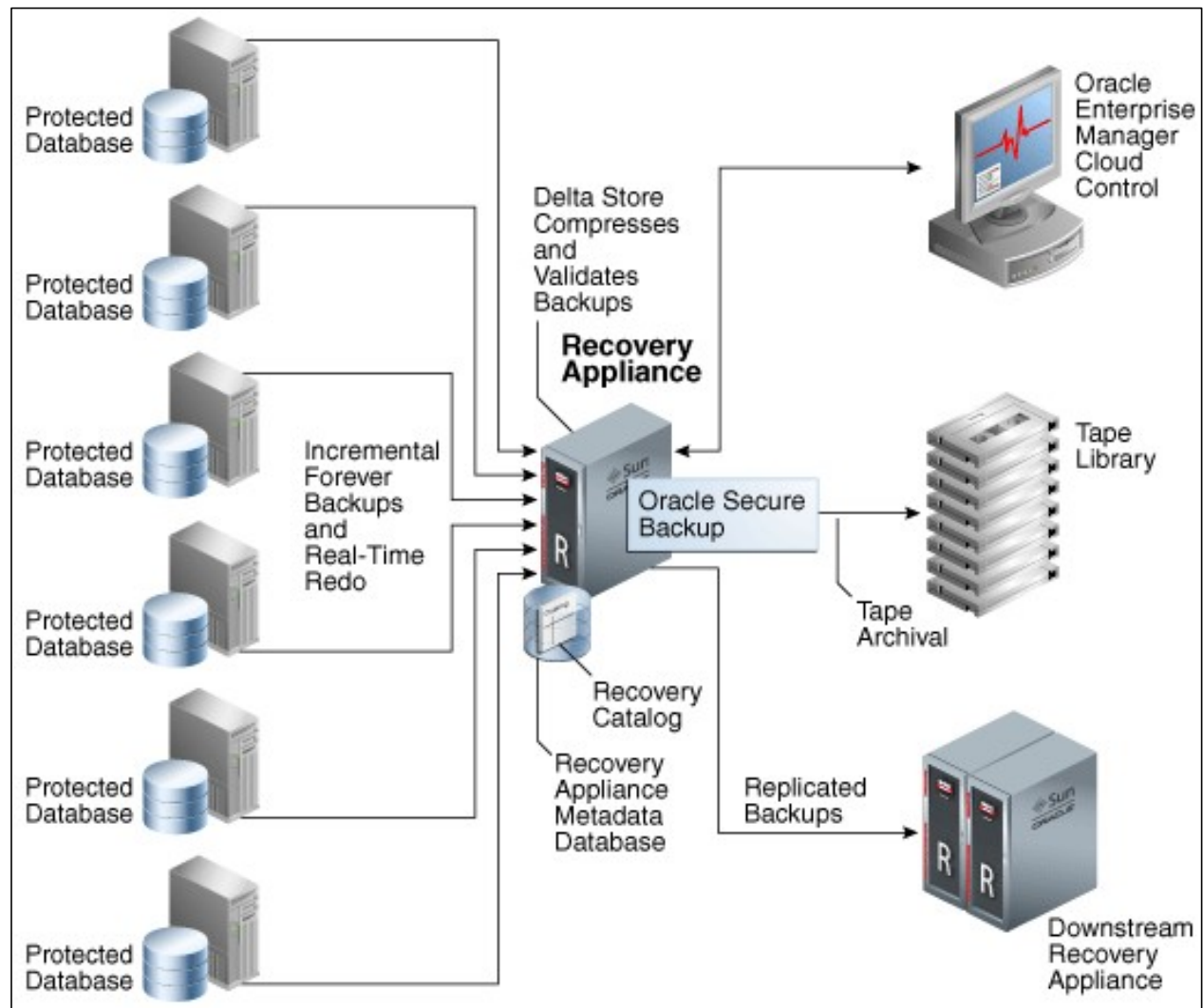
List of Backup Sets
=====

BS Key   Size       Device Type Elapsed Time Completion Time
-----
13314   21.50K     SBT_TAPE    00:00:01     01/01/2020 22:32:09
        BP Key: 13315   Status: AVAILABLE Compressed: YES Tag: TAG20200101T223208
        Handle: $RSCN_1920977_RTIM_1028557385_THRD_1_SEQ_91_CTKEY_13291_BACKUP Media:

List of Archived Logs in backup set 13314
-----
Thrd Seq      Low SCN    Low Time           Next SCN    Next Time
-----
1     91         2519988    01/01/2020 22:31:20 2520099     01/01/2020 22:31:51

RMAN>

```





## ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- The process to enroll/protect a database is simple:
  1. Define **Virtual Private Catalog** (VPC) user, Create **Protection Policy**,
  2. Link the database with VPC and policy.
  3. Install the library at the client and configure the wallet.
  4. Register the database with RMAN.
  5. Backup.

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- **Create VPC:**

- Virtual Private Catalog (VPC) user defines the catalog access at your RMAN connection.
- It is not the RMAN catalog, is just the user to access it.
- Can be created using EM/CC/CLI.
- Don't need to be created for all databases, can be used by 1 to N databases.

```
[root@zdlras1n1 ~]# /opt/oracle.RecoveryAppliance/bin/racli add vpc_user --user_name=vpcwebi
[vpcwebi] New Password:
Sun Oct  3 17:40:15 2019: Start: Add vpc user vpcwebi.
Sun Oct  3 17:40:15 2019:      Add vpc user vpcwebi successfully.
Sun Oct  3 17:40:15 2019: End:   Add vpc user vpcwebi.
[root@zdlras1n1 ~]#
```

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- **Create Policy:**

- **Most important** part of ZDLRA usage and reliability.
- Every database is linked with one policy.
- Where you define the recovery window constraints.
- ZDLRA control the backup expiration based on the policy:
  - If you define 30 days for recovery window at rman, but for policy, you define 15 days, the backups will be removed after 15 days.
- Different retention for disk and tapes.

```
SQL> BEGIN
 2  DBMS_RA.CREATE_PROTECTION_POLICY(
 3      protection_policy_name => 'ZDLRA_30DAYS'
 4      , description => 'Policy ZDLRA 30DAYS'
 5      , storage_location_name => 'DELTA'
 6      , recovery_window_goal => INTERVAL '30' DAY
 7      , max_retention_window => INTERVAL '60' DAY
 8      , recovery_window_sbt => INTERVAL '120' DAY
 9      , guaranteed_copy => 'NO'
10      , allow_backup_deletion => 'YES'
11  );
12  END;
13  /
```

PL/SQL procedure successfully completed.

```
SQL>
```

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- **Add database:**

- Link database with the VPC and the protection policy.
- Defines the reserved space for the database inside the “delta store”.

```
SQL> BEGIN
 2  DBMS_RA.ADD_DB(
 3      db_unique_name => 'ORCL18C'
 4      , protection_policy_name => 'ZDLRA_30DAYS'
 5      , reserved_space => '50G'
 6  );
 7  END;
 8  /
```

PL/SQL procedure successfully completed.

SQL>

```
SQL> BEGIN
 2  DBMS_RA.GRANT_DB_ACCESS (
 3      db_unique_name => 'ORCL18C'
 4      , username => 'vpcwebi'
 5  );
 6  END;
 7  /
```

PL/SQL procedure successfully completed.

SQL>

- **RESERVERED\_SPACE** needs to sustain the full backup + “incremental” + retention window.

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- **Client configuration:**

- Download library from MOS note [2219812.1](#)
- Unzip and copy to \$ORACLE\_HOME/lib.

```
[oracle@orcloel7 tmp]$ unzip ra_linux64.zip
Archive:  ra_linux64.zip
inflating:  libra.so
inflating:  metadata.xml
[oracle@orcloel7 tmp]$
[oracle@orcloel7 tmp]$ cp ./libra.so /u01/app/oracle/product/18.6.0.0/dbhome_1/lib/libra.so
[oracle@orcloel7 tmp]$
```

- Create the wallet for VPC and add the credential:

```
[oracle@orcloel7 tmp]$ mkstore -wrl $ORACLE_HOME/dbs/ra_wallet -createCredential zdlras1-scan:1521/zdlras1:VPCWEBI VPCWEBI s3nh4web1
Oracle Secret Store Tool Release 18.0.0.0.0 - Production
Version 18.1.0.0.0
Copyright (c) 2004, 2017, Oracle and/or its affiliates. All rights reserved.

[oracle@orcloel7 tmp]$
```

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- Register database:

```
[oracle@orcloel7 ~]$ rman target=/ catalog=vpcwebi/s3nh4web1@zdlras1-scan:1521/zdlras1

Recovery Manager: Release 18.0.0.0.0 - Production on Sun Dec 15 22:08:08 2019
Version 18.6.0.0.0

Copyright (c) 1982, 2018, Oracle and/or its affiliates. All rights reserved.

connected to target database: ORCL18C (DBID=558466555)
connected to recovery catalog database
recovery catalog schema version 19.03.00.00. is newer than RMAN version

RMAN> register database;

database registered in recovery catalog
starting full resync of recovery catalog
full resync complete

RMAN>
```

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- Channel configuration:

```
RMAN> CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' FORMAT '%d_%U' PARMS 'SBT_LIBRARY=/u01/app/oracle/product/18.6.0.0/dbhome_1/lib/libra.so,
ENV=(RA_WALLET='location=file:/u01/app/oracle/product/18.6.0.0/dbhome_1/dbs/ra_wallet credential_alias=zdlras1-scan:1521/zdlras1:VPCWEBI');

new RMAN configuration parameters:
CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' FORMAT '%d_%U' PARMS "SBT_LIBRARY=/u01/app/oracle/product/18.6.0.0/dbhome_1/lib/libra.so,
ENV=(RA_WALLET='location=file:/u01/app/oracle/product/18.6.0.0/dbhome_1/dbs/ra_wallet credential_alias=zdlras1-scan:1521/zdlras1:VPCWEBI')";
new RMAN configuration parameters are successfully stored
starting full resync of recovery catalog
full resync complete

RMAN>
```

- Look at the details:

- Device type.
- Library location.
- Credential location.
- Credential name.

# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- Backup Level 0:

```
RMAN> BACKUP INCREMENTAL LEVEL 0 DEVICE TYPE SBT FILESPERSET 1 FORMAT '%U' DATAFILE 1 TAG 'BKP-LEVEL0';

Starting backup at 18/10/2020 19:14:49
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: SID=65 device type=SBT_TAPE
channel ORA_SBT_TAPE_1: RA Library (ZDLRAS1) SID=B1F6229C7B58107CE053010310AC01FF
channel ORA_SBT_TAPE_1: starting incremental level 0 datafile backup set
channel ORA_SBT_TAPE_1: specifying datafile(s) in backup set
input datafile file number=00001 name=/u01/app/oracle/oradata/ORCL18C/system01.dbf
channel ORA_SBT_TAPE_1: starting piece 1 at 18/10/2020 19:15:26
channel ORA_SBT_TAPE_1: finished piece 1 at 18/10/2020 19:18:01
piece handle=afvda2me_1_1 tag=BKP-LEVEL0 comment=API Version 2.0,MMS Version 12.2.0.2
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:02:35
Finished backup at 18/10/2020 19:18:01

Starting Control File and SPFILE Autobackup at 18/10/2020 19:18:01
piece handle=c-558466555-20201018-00 comment=API Version 2.0,MMS Version 12.2.0.2
Finished Control File and SPFILE Autobackup at 18/10/2020 19:18:18

RMAN>
```



# ZDLRA - ENROLLING AND PROTECTING THE DATABASE

---

- **Subsequent Level 1:**

```
RMAN> BACKUP INCREMENTAL LEVEL 1 DEVICE TYPE SBT FILESPERSET 1 FORMAT '%U' DATAFILE 1 TAG 'BKP-DF1';

Starting backup at 18/10/2020 19:24:38
using channel ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: starting incremental level 1 datafile backup set
channel ORA_SBT_TAPE_1: specifying datafile(s) in backup set
input datafile file number=00001 name=/u01/app/oracle/oradata/ORCL18C/system01.dbf
channel ORA_SBT_TAPE_1: starting piece 1 at 18/10/2020 19:24:42
channel ORA_SBT_TAPE_1: finished piece 1 at 18/10/2020 19:24:57
piece handle=ahvda37q_1_1 tag=BKP-DF1 comment=API Version 2.0,MMS Version 12.2.0.2
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:00:15
Finished backup at 18/10/2020 19:24:57

Starting Control File and SPFILE Autobackup at 18/10/2020 19:24:57
piece handle=c-558466555-20201018-01 comment=API Version 2.0,MMS Version 12.2.0.2
Finished Control File and SPFILE Autobackup at 18/10/2020 19:25:14

RMAN>
```

# ZDLRA - PROTECTING THE DATABASE

```
RMAN> list backup of datafile 1;

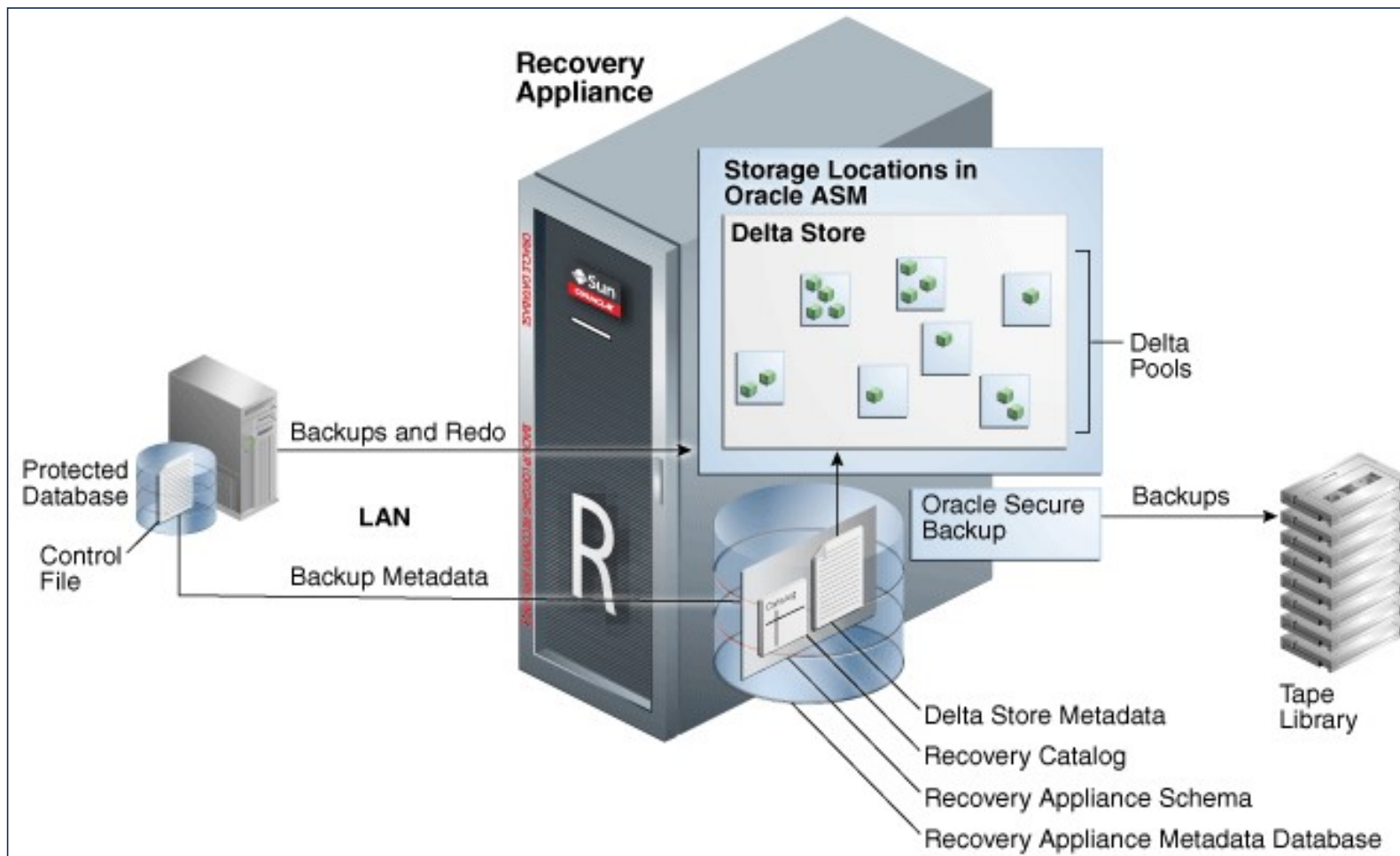
List of Backup Sets
=====

BS Key   Type LV Size          Device Type Elapsed Time Completion Time
-----
12460    Incr 0 330.99M   SBT_TAPE    00:02:28    18/10/2020 19:17:54
        BP Key: 12461   Status: AVAILABLE Compressed: YES Tag: BKP-LEVEL0
        Handle: VB$_1918343643_12441I Media:
List of Datafiles in backup set 12460
File LV Type Ckp SCN      Ckp Time          Abs Fuz SCN Sparse Name
-----
1       0   Incr 2046957 18/10/2020 19:15:26          NO /u01/app/oracle/oradata/ORCL18C/system01.dbf

BS Key   Type LV Size          Device Type Elapsed Time Completion Time
-----
12493    Incr 1 96.00K    SBT_TAPE    00:00:13    18/10/2020 19:24:55
        BP Key: 12494   Status: AVAILABLE Compressed: YES Tag: BKP-DF1
        Handle: VB$_1918343643_12488I Media:
List of Datafiles in backup set 12493
File LV Type Ckp SCN      Ckp Time          Abs Fuz SCN Sparse Name
-----
1       1   Incr 2048451 18/10/2020 19:24:42          NO /u01/app/oracle/oradata/ORCL18C/system01.dbf

BS Key   Type LV Size          Device Type Elapsed Time Completion Time
-----
12516    Incr 0 329.89M   SBT_TAPE    00:00:13    18/10/2020 19:24:55
        BP Key: 12517   Status: AVAILABLE Compressed: YES Tag: BKP-DF1
        Handle: VB$_1918343643_12488_1 Media:
List of Datafiles in backup set 12516
File LV Type Ckp SCN      Ckp Time          Abs Fuz SCN Sparse Name
-----
1       0   Incr 2048451 18/10/2020 19:24:42          NO /u01/app/oracle/oradata/ORCL18C/system01.dbf

RMAN>
```



# ZDLRA, INTERNAL DETAILS

---

- ZDLRA tables and views, **RASYS** owner:
  - **RA\_DATABASE**: Information about databases for ZDLRA, policy, and space usage.
  - **RA\_TASK**: All tasks running inside ZDLRA.
  - **VBDF**: Store the reference for **Virtual Backup Data File**, including the source backup piece for the virtual backup.
  - **PLANS** and **PLANS\_DETAIL**: The number of plans and the details for one virtual backup:
    - Together they are the “INDEX”.
  - **BLOCKS**: Store information for each data file block. Is a matrix/index for each data file.

# ZDLRA, INTERNAL DETAILS

---

- Backup Datafile:

```

RMAN> BACKUP INCREMENTAL LEVEL 0 DEVICE TYPE SBT FILESPERSET 1 DATAFILE 5;

Starting backup at 22-09-2019_17:54:27
...
Finished Control File and SPFILE Autobackup at 22-09-2019_17:54:30

RMAN>

RMAN> list backup of datafile 5;

List of Backup Sets
=====

BS Key   Type LV Size           Device Type Elapsed Time Completion Time
-----
2729    Incr 0  40.00K           SBT_TAPE    00:00:02    22-09-2019_17:54:30
        BP Key: 2730 Status: AVAILABLE Compressed: YES Tag: TAG20190922T175427
        Handle: VB$_1887643964_2728I Media:
List of Datafiles in backup set 2729
File LV Type Ckp SCN      Ckp Time          Abs Fuz SCN Sparse Name
-----
5     0   Incr 2320763    22-09-2019_17:54:28          NO    /u01/app/oracle/oradata/ORCL19/simon01.dbf

RMAN>

```

# ZDLRA, INTERNAL DETAILS

- Inside ZDLRA tables:

```
SQL> select db_key, dbinc_key from rc_database where name = 'ORCL19';
```

| DB_KEY | DBINC_KEY |
|--------|-----------|
| 2202   | 2203      |

```
SQL>
```

```
SQL> select df_key, file#, ts#, create_scn, create_time, block_size, blocks from df where dbinc_key = 2203 and file# = 5;
```

| DF_KEY | FILE# | TS# | CREATE_SCN | CREATE_TI | BLOCK_SIZE | BLOCKS |
|--------|-------|-----|------------|-----------|------------|--------|
| 2689   | 5     | 6   | 2319183    | 22-SEP-19 | 8192       | 128    |

```
SQL>
```

```
SQL> select vb_key, ckp_scn, vcbp_key, srcbp_key, blocks, chunks_used from vbdf where db_key = 2202 and df_key = 2689 order by vb_key asc;
```

| VB_KEY | CKP_SCN | VCBP_KEY | SRCBP_KEY | BLOCKS | CHUNKS_USED |
|--------|---------|----------|-----------|--------|-------------|
| 2728   | 2320763 | 2730     | 2701      | 128    | 1           |

```
SQL>
```

```
SQL> select * from plans where db_key = 2202 and df_key = 2689 order by vb_key asc;
```

| TYPE | DB_KEY | VB_KEY | DF_KEY | TASK_ID | OLD | BLKSREAD | MAXRANK | NUMCHUNKS | READSIZE | NEEDCHUNK | FREECHUNK |
|------|--------|--------|--------|---------|-----|----------|---------|-----------|----------|-----------|-----------|
| 8    | 2202   | 2728   | 2689   |         |     | 19       | 1       | 1         |          |           |           |

```
SQL>
```

# ZDLRA, INTERNAL DETAILS

- Plans\_details table:

```
SQL> select * from plans_details where df_key = 2689 order by vb_key asc, blockno asc;
```

| DF_KEY | TYPE | VB_KEY | BLKRANK | BLOCKNO    | CHUNKNO | NUMBLKS | COFFSET | NUMBYTES |
|--------|------|--------|---------|------------|---------|---------|---------|----------|
| 2689   | 8    | 2728   | 1       | 0          | 1       | 1       | 8192    | 24576    |
| 2689   | 8    | 2728   | 1       | 2          | 1       | 17      | 32788   | 2167     |
| 2689   | 8    | 2728   | 1       | 4294967295 | 1       | 1       | 34955   | 294      |

SQL>



- The datafile block 0 (column BLOCKNO) until block 1 (**BLOCKNO+NUMBLKS**) is stored at chunk 1.
- The datafile block 2 (column BLOCKNO) until block 19 (**BLOCKNO+NUMBLKS**) are stored at chunk 1.

# ZDLRA, INTERNAL DETAILS

```

RMAN> BACKUP INCREMENTAL LEVEL 1 DEVICE TYPE SBT FILESPERSET 1 DATAFILE 5;
...
Finished Control File and SPFILE Autobackup at 22-09-2019_18:34:36
RMAN> list backup of datafile 5;

List of Backup Sets
=====

BS Key Type LV Size Device Type Elapsed Time Completion Time
-----
2729 Incr 0 40.00K SBT_TAPE 00:00:02 22-09-2019_17:54:30
BP Key: 2730 Status: AVAILABLE Compressed: YES Tag: TAG20190922T175427
Handle: VBS_2087643964_2728I Media:
List of Datafiles in backup set 2729
File LV Type Ckp SCN Ckp Time Abs Fuz SCN Sparse Name
-----
5 0 Incr 2320763 22-09-2019_17:54:28 NO /u01/app/oracle/oradata/ORCL19/simon01.dbf
  
```

Inside ZDLRA tables:

```

BS Key Type LV Size
-----
2769 Incr 1 80.00K
BP Key: 2770
Handle: VBS_2322525I
List of Datafiles in
File LV Type Ckp SCN
-----
5 1 Incr 2322525

SQL> select vb_key, ckp_scn, vcbp_key, srcbp_key, blocks, chunks_used from vbdf where db_key = 2202 and df_key = 2689 order by vb_key asc;

```

| VB_KEY | CKP_SCN | VCBP_KEY | SRCBP_KEY | BLOCKS | CHUNKS_USED |
|--------|---------|----------|-----------|--------|-------------|
| 2728   | 2320763 | 2730     | 2701      | 128    | 1           |
| 2768   | 2322525 | 2770     | 2735      | 128    | 1           |

```

BS Key Type LV Size
-----
2773 Incr 0 69.00K
BP Key: 2774
Handle: VBS_18
List of Datafiles in
File LV Type Ckp SCN
-----
5 0 Incr 2322525

SQL> select * from plans where db_key = 2202 and df_key = 2689 order by vb_key asc;

```

| TYPE | DB_KEY | VB_KEY | DF_KEY | TASK_ID | OLD | BLKSREAD | MAXRANK | NUMCHUNKS | READSIZE | NEEDCHUNK | FREECHUNK |
|------|--------|--------|--------|---------|-----|----------|---------|-----------|----------|-----------|-----------|
| 8    | 2202   | 2728   | 2689   |         |     | 19       | 1       | 1         |          |           |           |
| 1    | 2202   | 2768   | 2689   |         |     | 27       | 1       | 2         |          |           |           |

```

RMAN>
SQL>
  
```



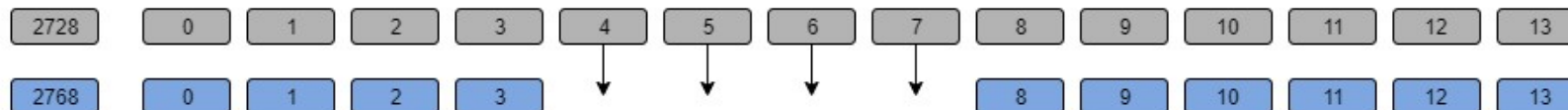
# ZDLRA, INTERNAL DETAILS

```
SQL> select * from plans_details where df_key = 2689 order by vb_key asc, blockno asc;
```

| DF_KEY | TYPE | VB_KEY      | BLKRANK | BLOCKNO    | CHUNKNO     | NUMBLKS  | COFFSET | NUMBYTES |
|--------|------|-------------|---------|------------|-------------|----------|---------|----------|
| 2689   | 8    | 2728        | 1       | 0          | 1           | 1        | 8192    | 24576    |
| 2689   | 8    | 2728        | 1       | 2          | 1           | 17       | 32788   | 2167     |
| 2689   | 8    | 2728        | 1       | 4294967295 | 1           | 1        | 34955   | 294      |
| 2689   | 1    | <b>2768</b> | 1       | <b>0</b>   | <b>1025</b> | <b>1</b> | 8192    | 24576    |
| 2689   | 1    | <b>2768</b> | 1       | <b>2</b>   | 1025        | 2        | 32788   | 252      |
| 2689   | 1    | <b>2768</b> | 1       | <b>4</b>   | <b>1</b>    | <b>4</b> | 33038   | 408      |
| 2689   | 1    | <b>2768</b> | 1       | 6          | 1025        | 16       | 33040   | 45339    |
| 2689   | 1    | <b>2768</b> | 1       | 71         | 1           | 3        | 34703   | 252      |
| 2689   | 1    | <b>2768</b> | 1       | 4294967295 | 1025        | 1        | 78379   | 293      |

9 rows selected.

- The datafile block 0 (column BLOCKNO) until block 1 (BLOCKNO+NUMBLKS) are stored at chunk 1025.
- The datafile block 2 (column BLOCKNO) until block 4 (BLOCKNO+NUMBLKS) are stored at chunk 1025.
- The datafile block 4 (column BLOCKNO) until block 8 (BLOCKNO+NUMBLKS) are stored at chunk 1 (and came from previous virtual full backup).
- The datafile block 8 (column BLOCKNO) until block 24 (BLOCKNO+NUMBLKS) are stored at chunk 1025.



## ZDLRA, INTERNAL DETAILS

```
SQL> select * from plans_details where df_key = 2689 order by vb_key asc, blockno asc;
```

| DF_KEY | TYPE | VB_KEY      | BLKRANK | BLOCKNO    | CHUNKNO     | NUMBLKS   | COFFSET | NUMBYTES |
|--------|------|-------------|---------|------------|-------------|-----------|---------|----------|
| 2689   | 1    | <b>2768</b> | 1       | 0          | <b>1025</b> | 1         | 8192    | 24576    |
| 2689   | 1    | 2768        | 1       | 2          | 1025        | 2         | 32788   | 252      |
| 2689   | 1    | 2768        | 1       | 4          | 1           | 4         | 33038   | 408      |
| 2689   | 1    | 2768        | 1       | 8          | <b>1025</b> | <b>16</b> | 33040   | 45339    |
| 2689   | 1    | 2768        | 1       | 71         | 1           | 3         | 34703   | 252      |
| 2689   | 1    | 2768        | 1       | 4294967295 | 1025        | 1         | 78379   | 293      |
| ...    |      |             |         |            |             |           |         |          |
| ...    |      |             |         |            |             |           |         |          |
| 2689   | 1    | <b>3002</b> | 1       | 0          | <b>5121</b> | 1         | 8192    | 24576    |
| 2689   | 1    | 3002        | 1       | 2          | 5121        | 2         | 32788   | 255      |
| 2689   | 1    | <b>3002</b> | 1       | <b>4</b>   | <b>1</b>    | <b>4</b>  | 33038   | 408      |
| 2689   | 1    | 3002        | 1       | 8          | 3073        | 1         | 32788   | 262      |
| 2689   | 1    | 3002        | 1       | 9          | 1025        | 1         | 33293   | 128      |
| 2689   | 1    | 3002        | 1       | 10         | 5121        | 1         | 33043   | 215      |
| 2689   | 1    | 3002        | 1       | 11         | 3073        | 13        | 33050   | 94555    |
| 2689   | 1    | 3002        | 1       | 24         | 5121        | 28        | 33258   | 4986     |
| 2689   | 1    | 3002        | 1       | 52         | 1           | 1         | 34703   | 84       |
| 2689   | 1    | 3002        | 1       | 56         | 5121        | 8         | 38244   | 1168     |
| 2689   | 1    | 3002        | 1       | 72         | 1           | 1         | 34787   | 84       |
| 2689   | 1    | 3002        | 1       | 128        | 5121        | 843       | 39412   | 125460   |
| 2689   | 1    | 3002        | 1       | 4294967295 | 5121        | 1         | 164872  | 301      |

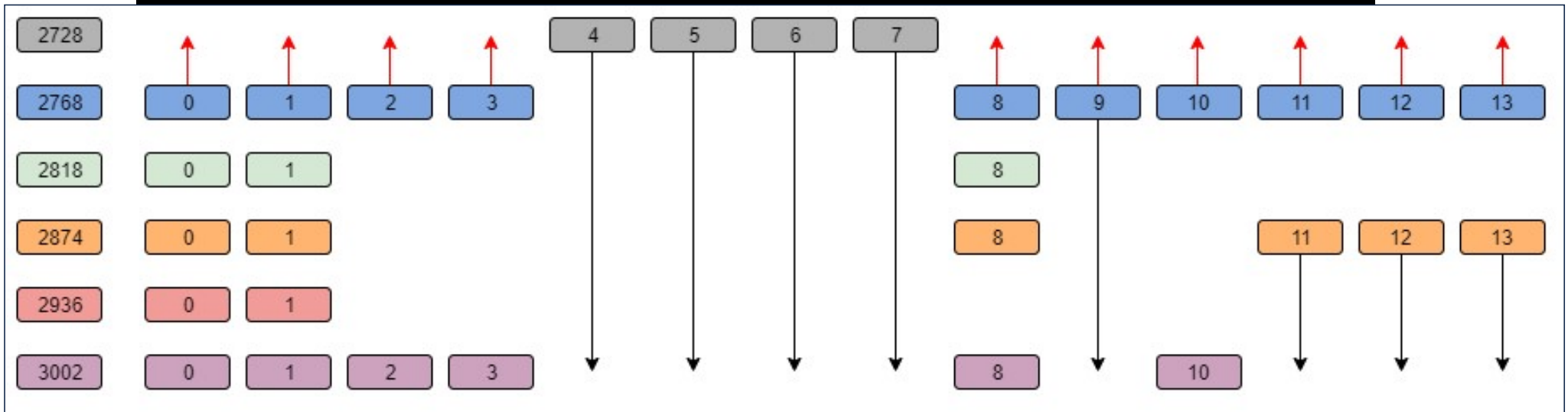
```
45 rows selected.
```

```
SQL>
```

# ZDLRA, INTERNAL DETAILS

```
SQL> select * from plans_details where df_key = 2689 order by vb_key asc, blockno asc;
```

| DF_KEY | TYPE | VB_KEY      | BLKRANK | BLOCKNO    | CHUNKNO     | NUMBLKS   | COFFSET | NUMBYTES |
|--------|------|-------------|---------|------------|-------------|-----------|---------|----------|
| 2689   | 1    | <b>2768</b> | 1       | 0          | <b>1025</b> | 1         | 8192    | 24576    |
| 2689   | 1    | 2768        | 1       | 2          | 1025        | 2         | 32788   | 252      |
| 2689   | 1    | 2768        | 1       | 4          | 1           | 4         | 33038   | 408      |
| 2689   | 1    | 2768        | 1       | 8          | <b>1025</b> | <b>16</b> | 33040   | 45339    |
| 2689   | 1    | 2768        | 1       | 71         | 1           | 3         | 34703   | 252      |
| 2689   | 1    | 2768        | 1       | 4294967295 | 1025        | 1         | 78379   | 293      |



- Unnecessary data are deleted from time to time to avoid redundancy and to be more space-efficient.
  - Called “automated delta pool space management”, specifically the “delta pool optimization”.

## ZDLRA, INTERNAL DETAILS

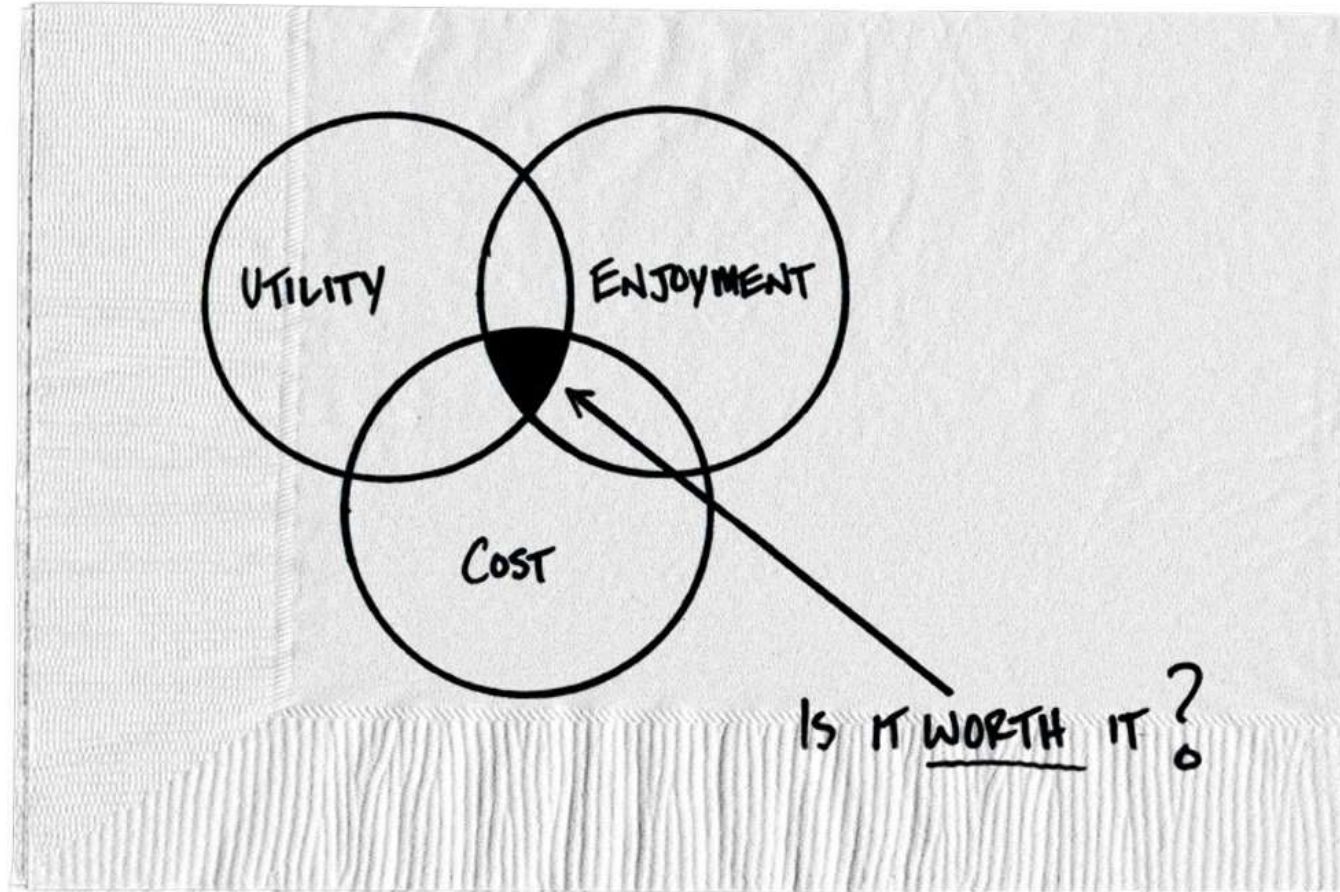
---

- Every rman backupset is deconstructed and all datafile blocks are indexed, and stored:
  - The idea is linking virtual full backup of datafile (VBDF table) with one plan (PLAN(s) tables).
- Going further, does not exist 1 to 1 relation between the block and the virtual backup:
  - It is just a matrix of pointers for blocks inside chunks.
  - This is the reason that ZDLRA it is different; it can analyze block to block and index it efficiently.



## Q&A

---





## There is no MAA without ZDLRA!

**HrOUG 2021**  
12:15 – Hall A

**Fernando Simon**  
Senior Database Specialist  
Oracle ACE ♠

