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Oracle Database Backup-and-Recovery

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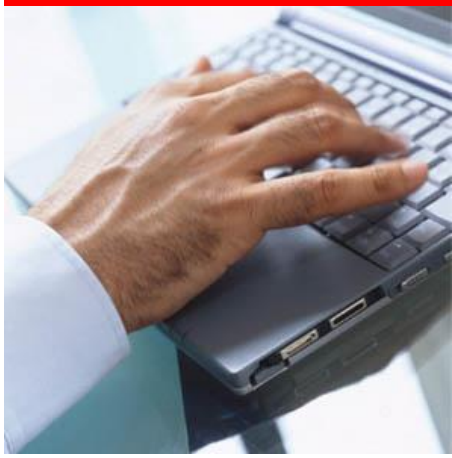
Agenda



- Purpose of Backup and Recovery.
- Oracle Data Protection Planning & Solutions
- Oracle Backup & Recovery Solutions
  - Physical Data Protection
    - Recovery Manager
  - Logical Data Protection
    - Flashback Technologies
  - Recovery Analysis
    - Data Recovery Advisor
- Q&A

Purpose of Backup and Recovery

Data Protection Concerns…

- **Backup administration tasks include the following:**
  - Planning and testing responses to different kinds of failures
  - Configuring the database environment for backup and recovery
  - Setting up a backup schedule
  - Monitoring the backup and recovery environment
  - Troubleshooting backup problems
  - Recovering from data loss if the need arises

Data Protection

- A **backup** is a copy of data of a database that you can use to reconstruct data.

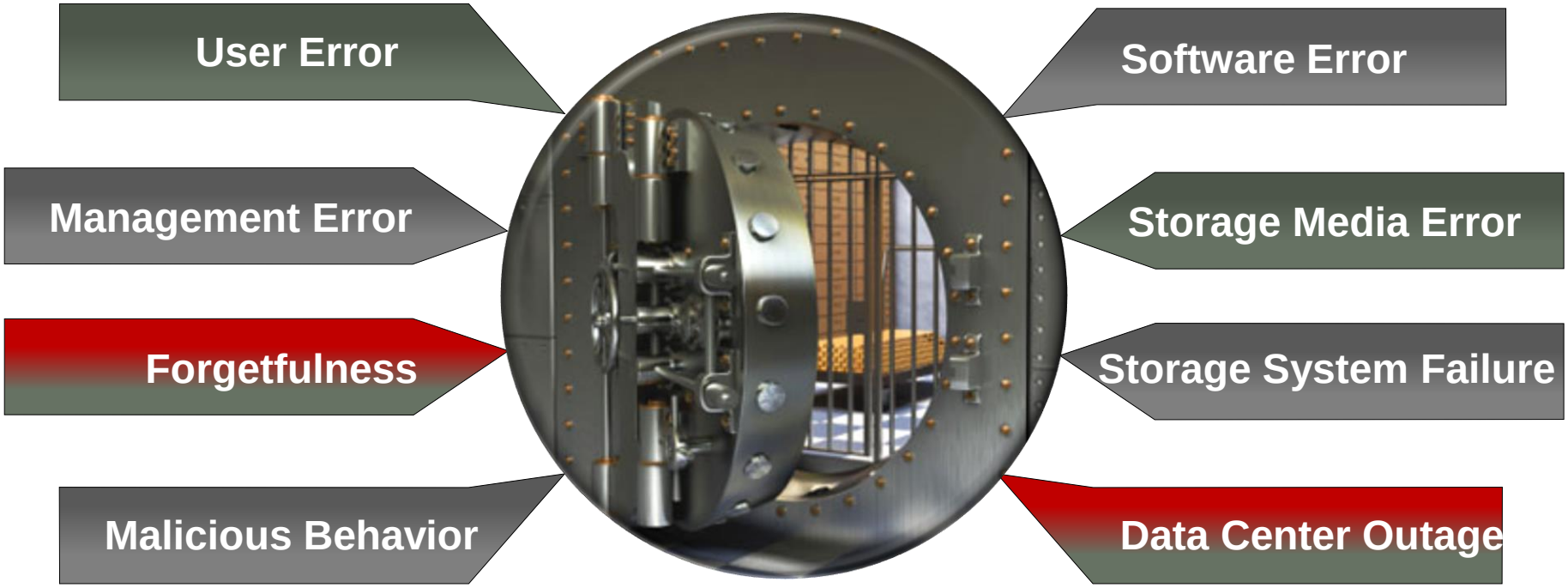
  - **Physical backup**

    Are copies of the physical files used in storing and recovering a database. These files include data files, control files, and archived redo logs.

  - **Logical backups**

    Contain logical data such as tables and stored procedures.

Many Types of Data Loss to Protect Against



Many Types of Data Loss to Protect Against

- **Media Failure**
  - A media failure is a physical problem with a disk,
  - That causes a failure of a read from or write to a disk file that is required to run the database.
- **User Errors**
  - User errors occur when, either due to an error in application logic or a manual mistake,
  - Data in a database is changed or deleted incorrectly.
  - User errors are estimated to be the greatest single cause of database downtime.

Tools for Oracle Database Data Protection

The Ultimate Integrated Data Protection Solution

Software Tools
Oracle Enterprise Manager,

Database Tools
Data Guard & Active Data Guard
Data Recovery Advisor, RMAN

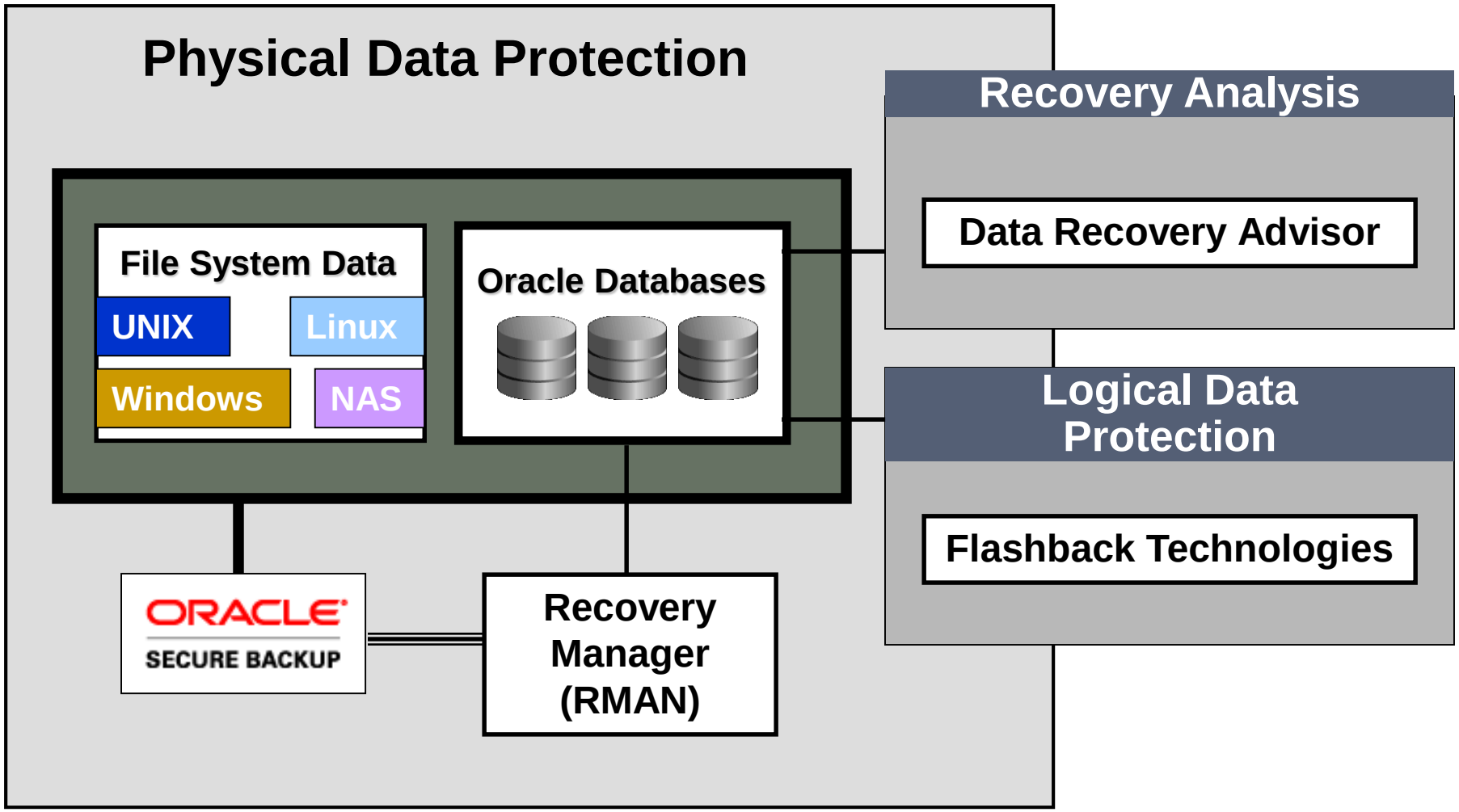
Operating System Tools
Built in Backup and Recovery Tools,
Snapshots, Boot Environments

Virtualization Tools
Oracle Virtual Machine, Enterprise Manager

Storage Tools
Snapshots, Replication, Archive, Analytics

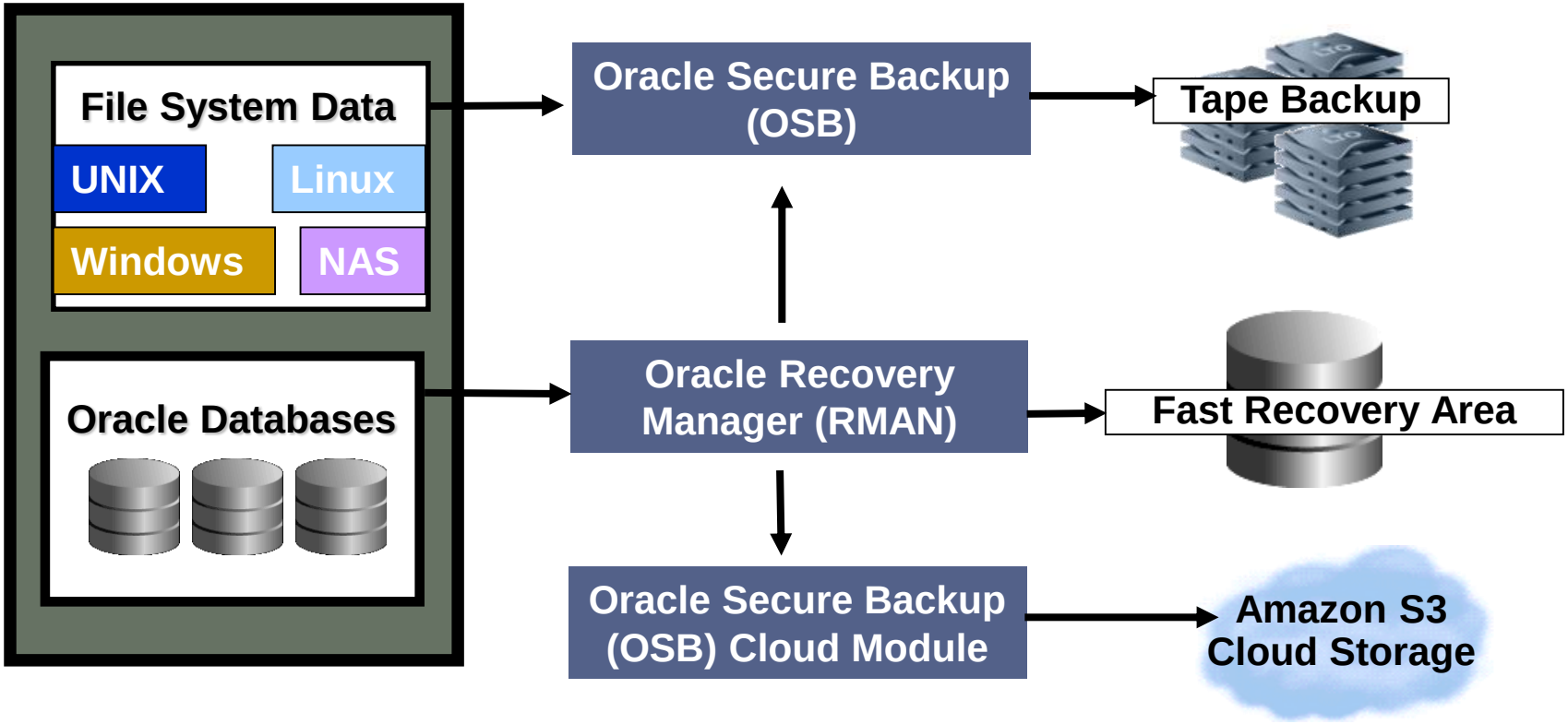
Oracle Backup & Recovery Solutions

"Backup and Recovery on Steroids"



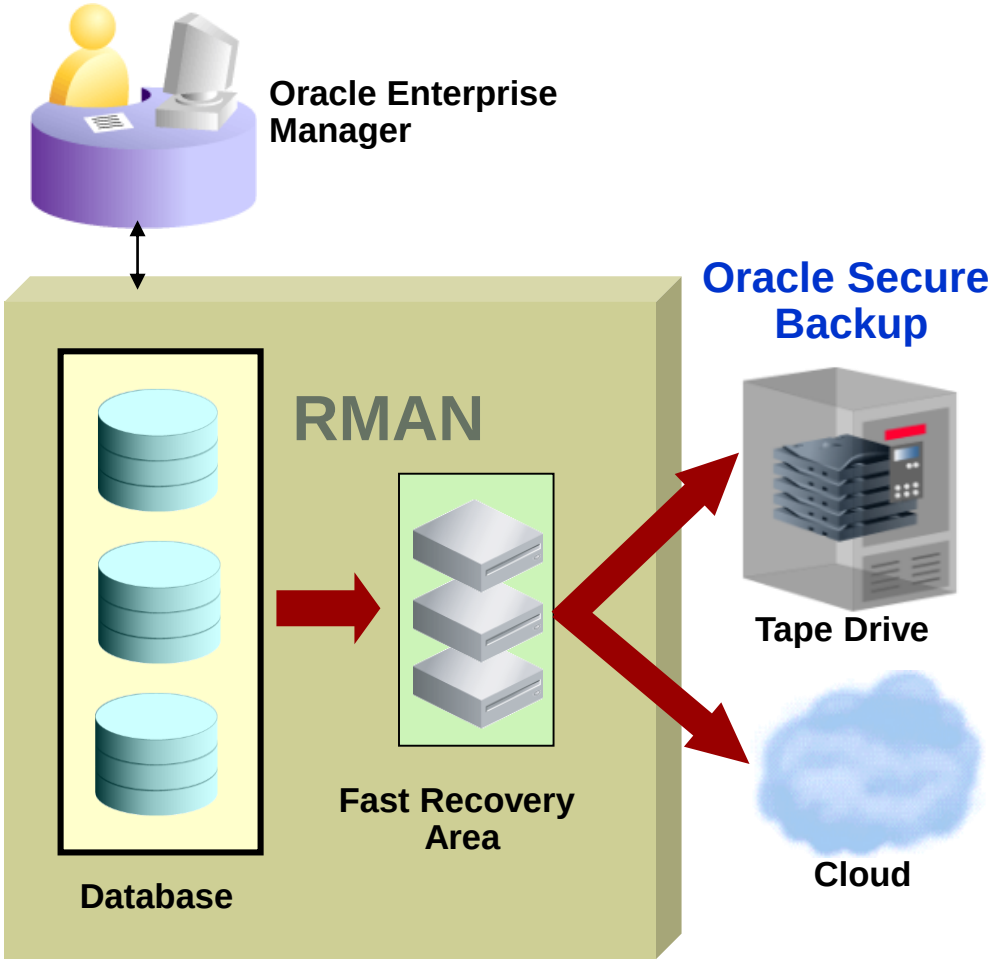
Backup & Recovery Foundation

Complete Oracle Solution from Disk to Tape



Oracle Recovery Manager (RMAN)

Oracle-integrated Backup & Recovery Engine



- Intrinsic knowledge of database file formats and recovery procedures
  - Block validation
  - Online block-level recovery
  - Tablespace/data file recovery
  - Online, multi-streamed backup
  - Unused block compression
  - Native encryption
- Integrated disk, tape & cloud backup leveraging the Fast Recovery Area and Oracle Secure Backup

Oracle Backup and Recovery Solutions

- **Recovery Manager (RMAN)**
  - Recovery Manager is fully integrated with the Oracle database to perform a range of backup and recovery activities.
  - You can access RMAN through the command line or through Oracle Enterprise Manager.
- **User-managed backup and recovery**
  - In this solution, you perform backup and recovery with a mixture of host operating system commands and SQL*Plus recovery commands.
  - You are responsible for determining all aspects of when and how backups and recovery are done.

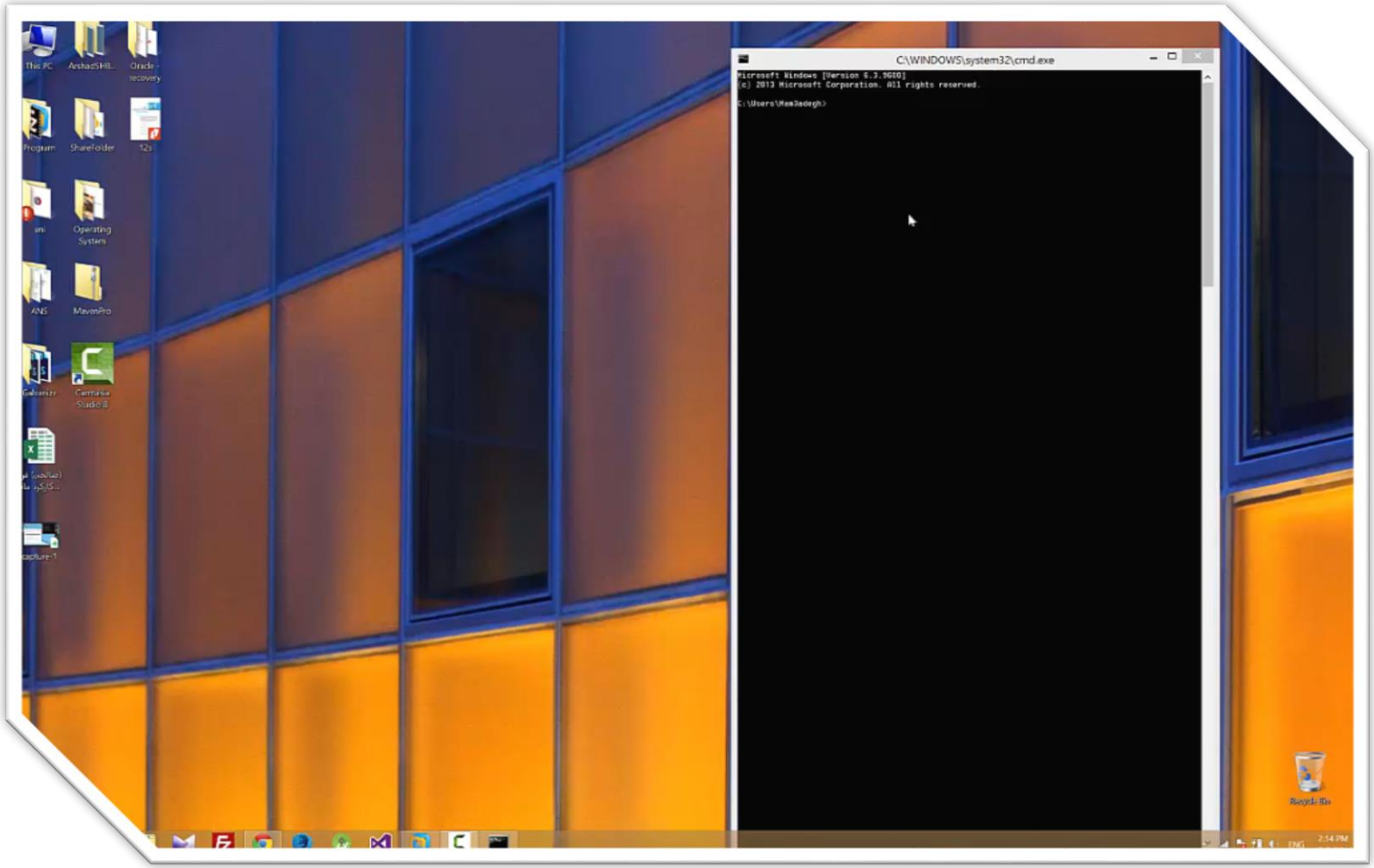
Feature Comparison of Backup Techniques

Feature	Recovery Manager	User-managed	Data Pump Export
Closed database backups	Supported.	Supported	Not supported.
Open database backups	Supported.	Supported.	Requires rollback or undo segments to generate consistent backups.
Incremental backups	Supported	Not supported.	Not supported.
Corrupt block detection	Supported.	Not supported.	Supported.
Automatic specification of files to include in a backup	Supported	Not supported.	Not applicable.
Backup repository	Supported	Not supported.	Not supported.

Feature Comparison of Backup Techniques

Feature	Recovery Manager	User-managed	Data Pump Export
Backups to a media manager	Supported.	Supported.	Not supported.
Backup of initialization parameter file	Supported.	Supported.	Not supported.
Backup of password and networking files	**Not supported.**	Supported.	Not supported.
Platform-independent language for backups	Supported.	Not supported.	Supported.

Start RMAN


C:\WINDOWS\system32\cmd.exe
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.
C:\Users\HamZadegh>

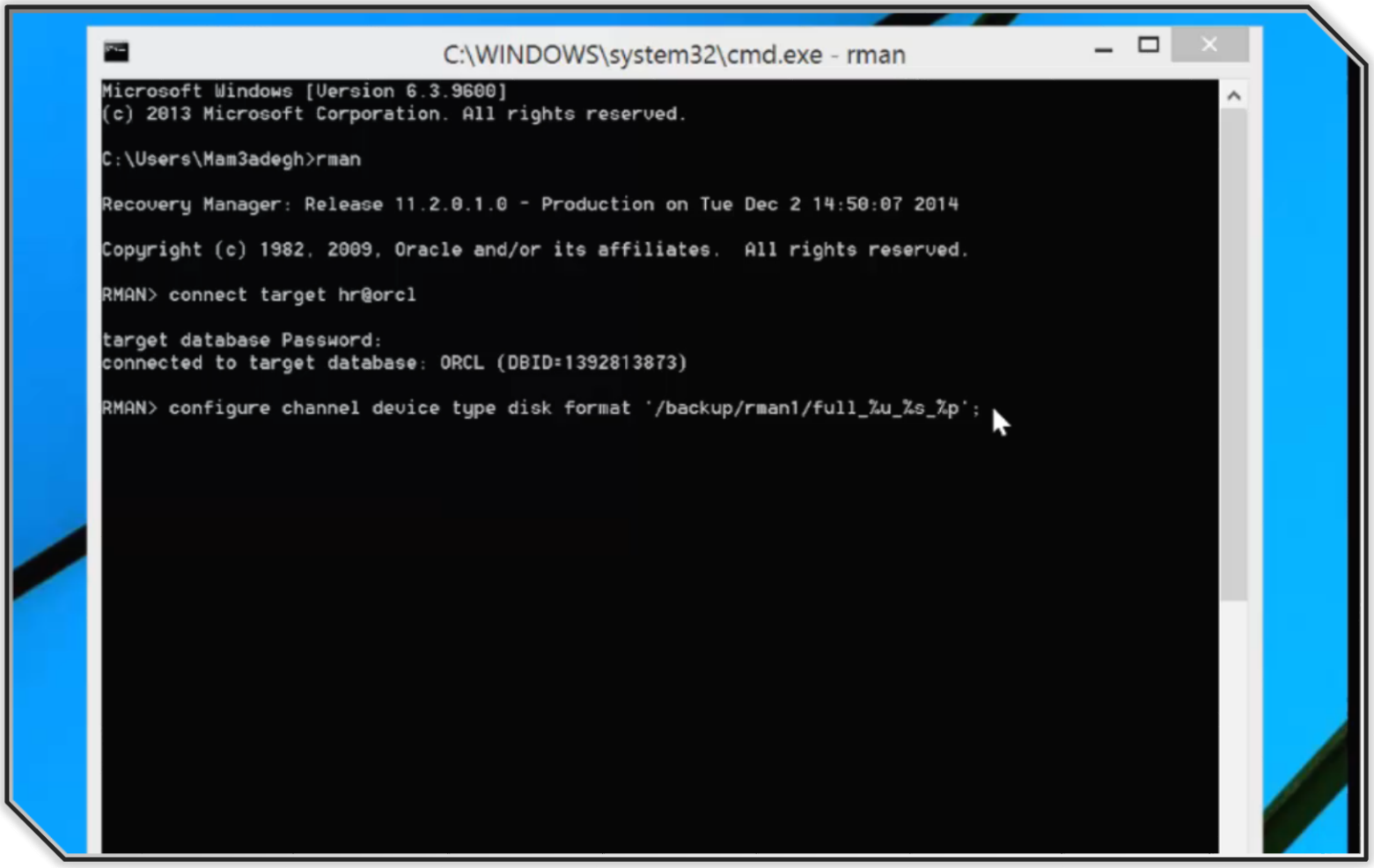
Change RMAN Backup Configuration

```
RMAN> CONFIGURE CHANNEL DEVICE TYPE DISK FORMAT '/backup/rman/full_%u_%s_%p';
```

```
RMAN> CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF 7 DAYS;
```

- **%U**, which generates a unique name.
- Others include **%d** for the DB_NAME,
- **%t** for the backup set time stamp,
- **%s** for the backup set number,
- And **%p** for the backup piece number.

Change RMAN Backup Configuration



Incremental backup

- Stores only blocks changed since a previous backup.
- Thus, they provide more compact backups and faster recovery,
- thereby reducing the need to apply redo during **data file media recovery**.

Incremental backup

- **Creates a level 0 incremental backup to serve as a base for an incremental backup strategy:**

```
BACKUP INCREMENTAL LEVEL 0 DATABASE;
```

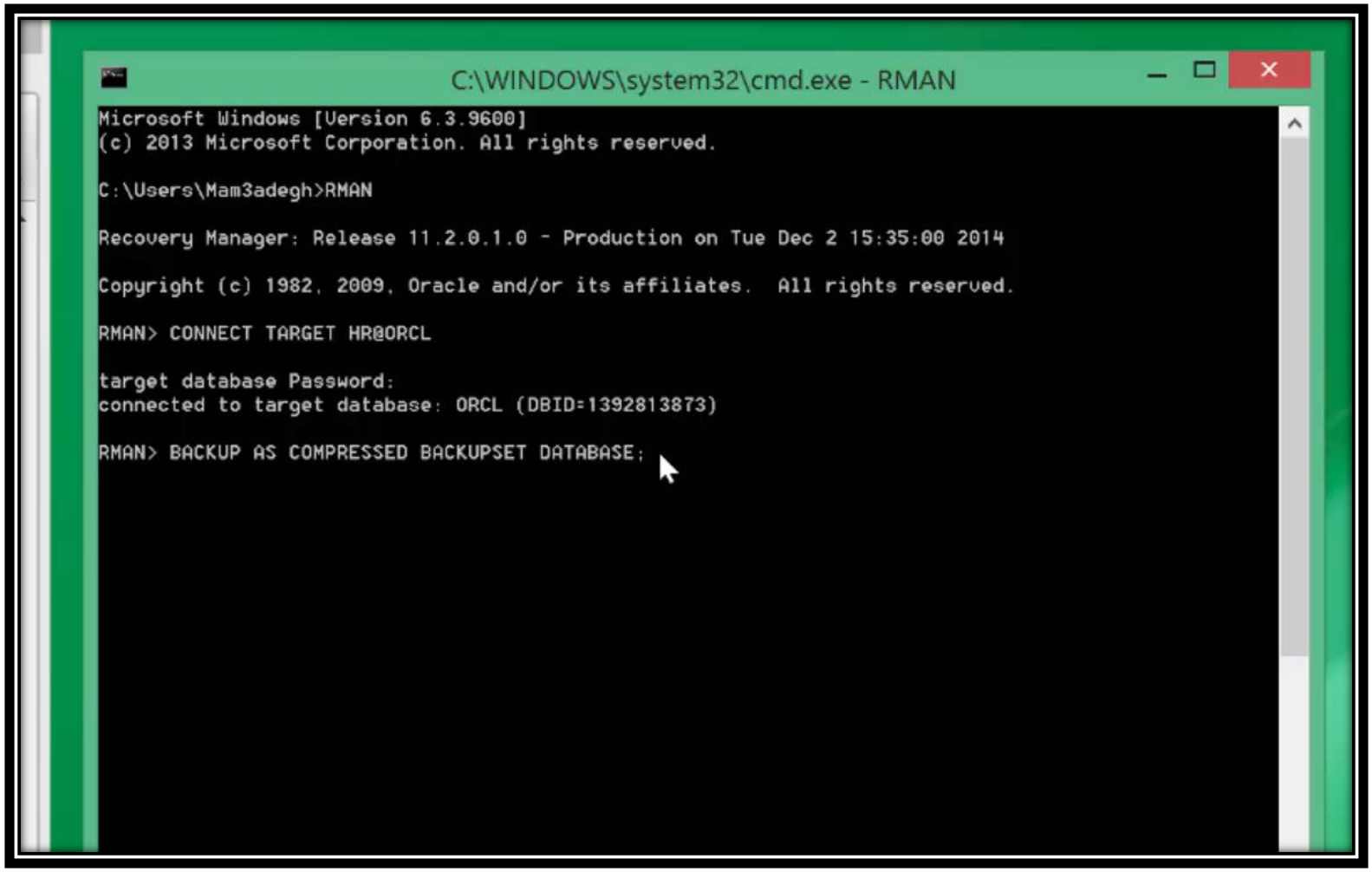
- **Creates a level 1 cumulative incremental backup:**

```
BACKUP INCREMENTAL LEVEL 1 CUMULATIVE DATABASE;
```

- **Creates a level 1 differential incremental backup:**

```
BACKUP INCREMENTAL LEVEL 1 DATABASE;
```

Incremental backup



Validating & Cross-checking Database Files and Backups

- Validate all database files and archived redo log files for physical and logical corruption:

```
BACKUP VALIDATE CHECK LOGICAL DATABASE ARCHIVELOG
ALL;
```

- Check individual data blocks, as shown in the following example:

```
VALIDATE DATAFILE 4 BLOCK 10 TO 13;
```

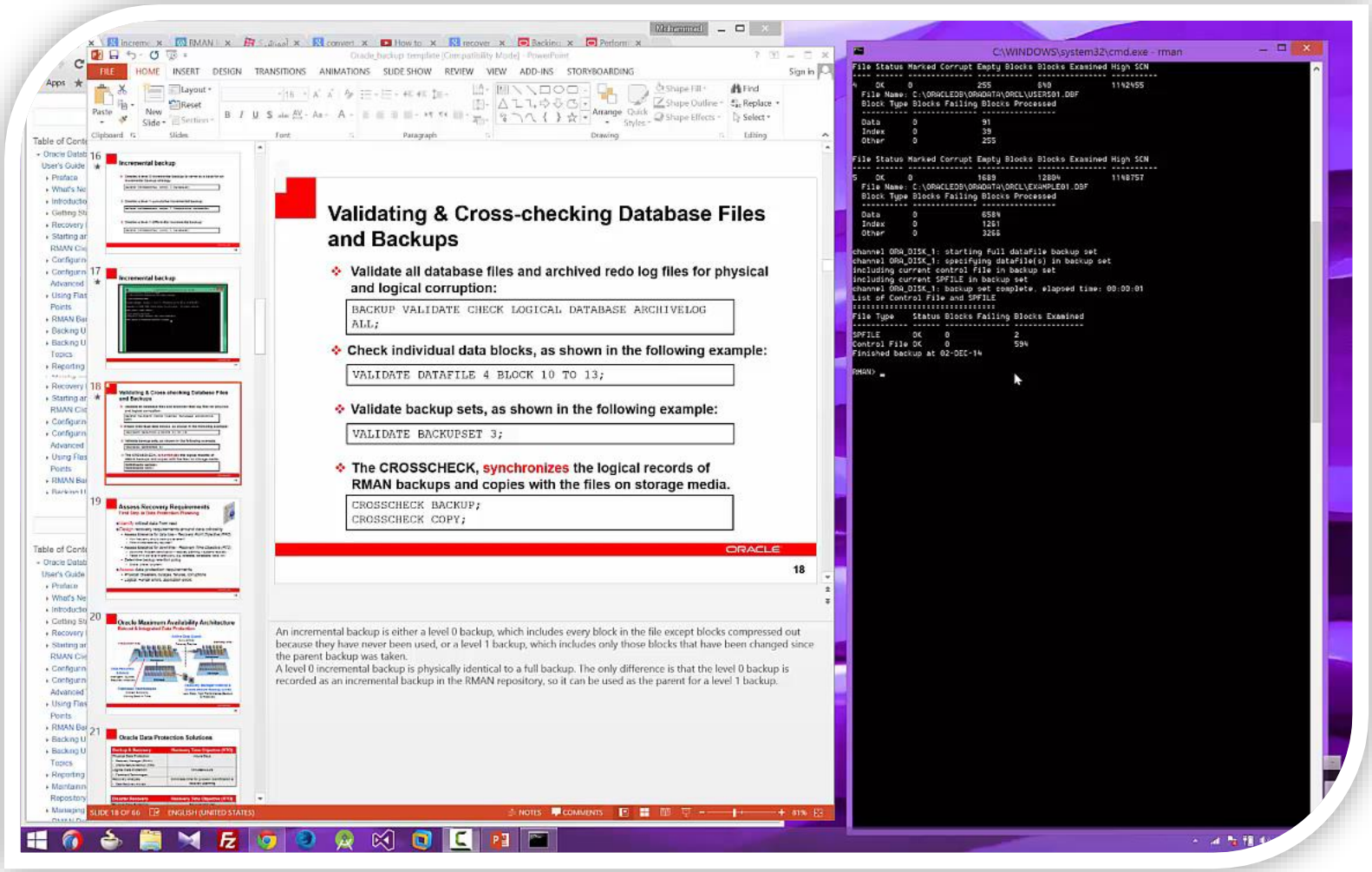
- Validate backup sets, as shown in the following example:

```
VALIDATE BACKUPSET 3;
```

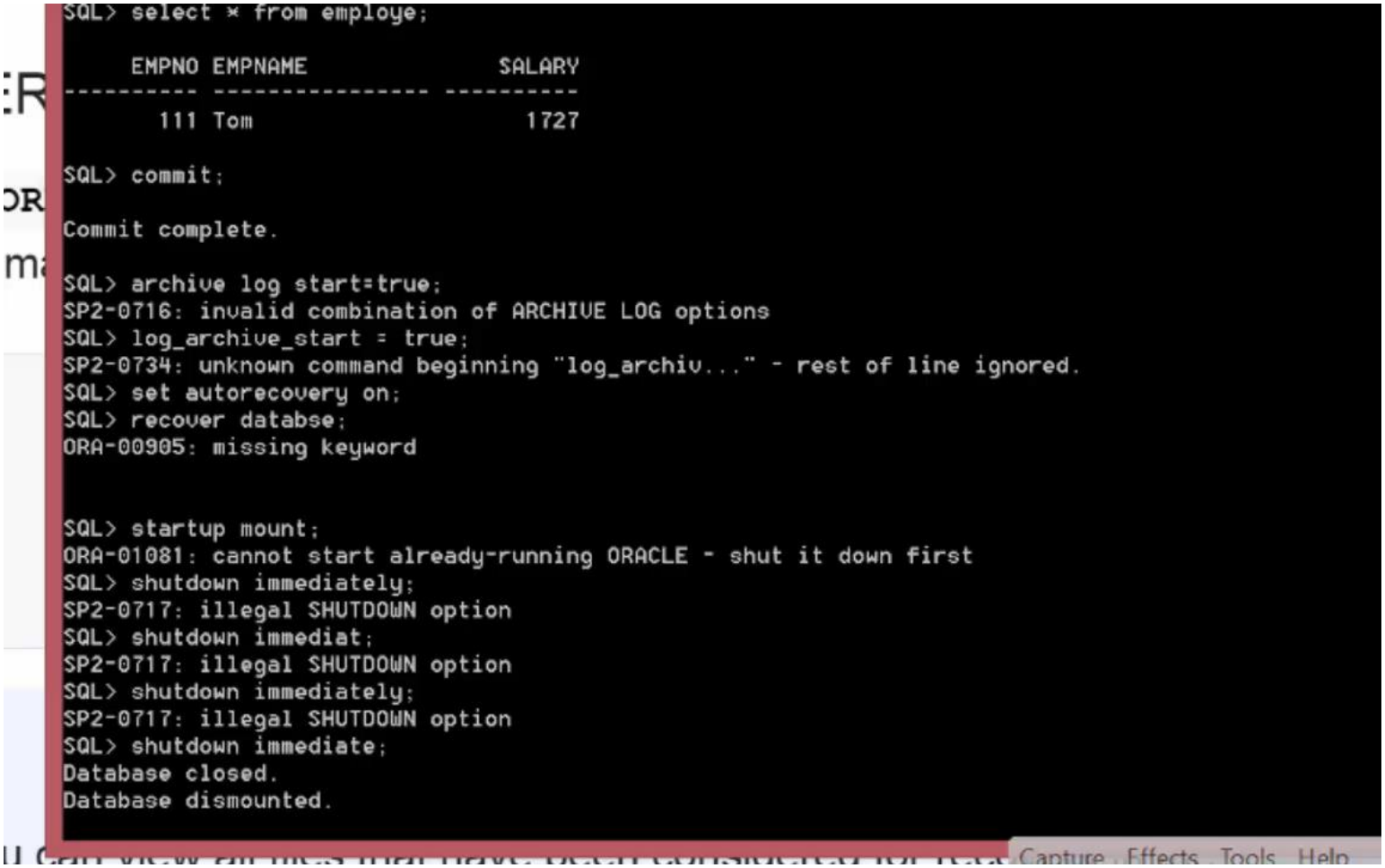
- The CROSSCHECK, synchronizes the logical records of RMAN backups and copies with the files on storage media.

```
CROSSCHECK BACKUP;
CROSSCHECK COPY;
```

Validating & Cross-checking Database Files and Backups



Recover Databae - RMAN

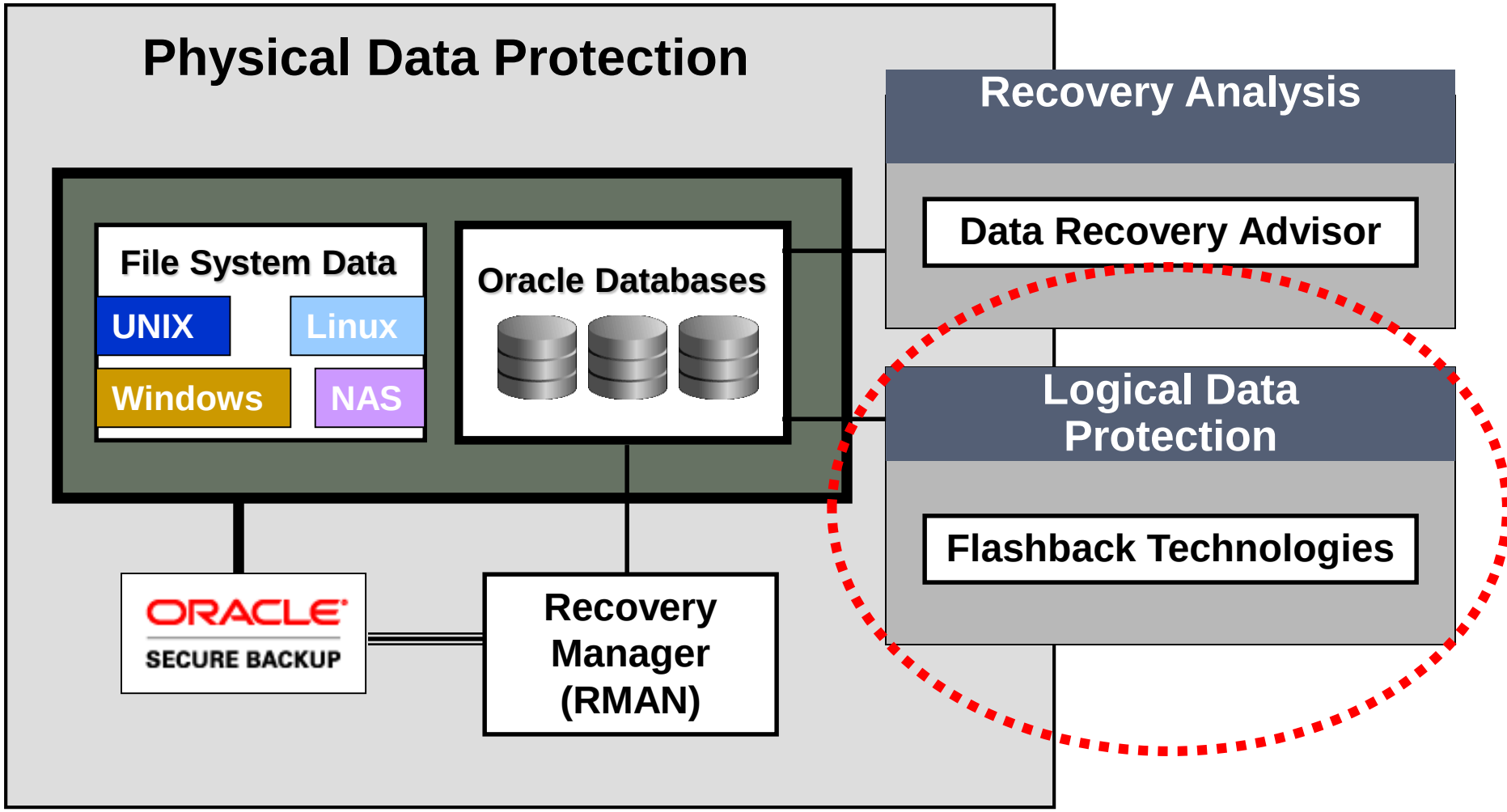


Additional Resources

- RMAN Step-by-Step Performance Tuning (NEW)
  - http://www.oracle.com/technology/deploy/availability/pdf/rman_tuning_mm_bp.pdf
- Very Large Database Backup & Recovery Best Practices
  - http://www.oracle.com/technology/deploy/availability/pdf/vldb_br.pdf
- Best Practices using Recovery Manager with Oracle Data Guard and Oracle Streams
  - http://www.oracle.com/technology/deploy/availability/pdf/oracle-openworld-2008/298772.pdf

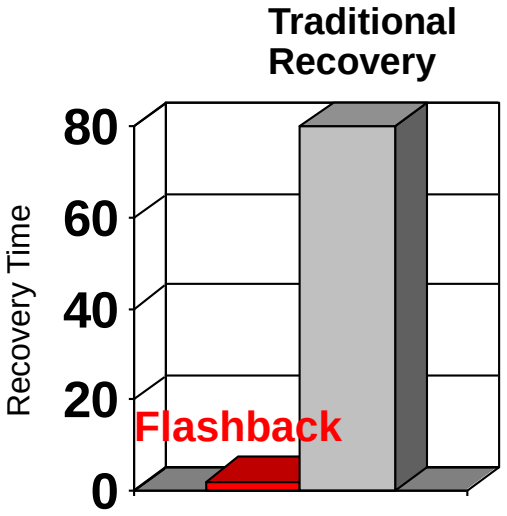
Logical Data Protection

Fast 'Rewind' of Logical Errors



Flashback Technologies

Error Detection & Correction

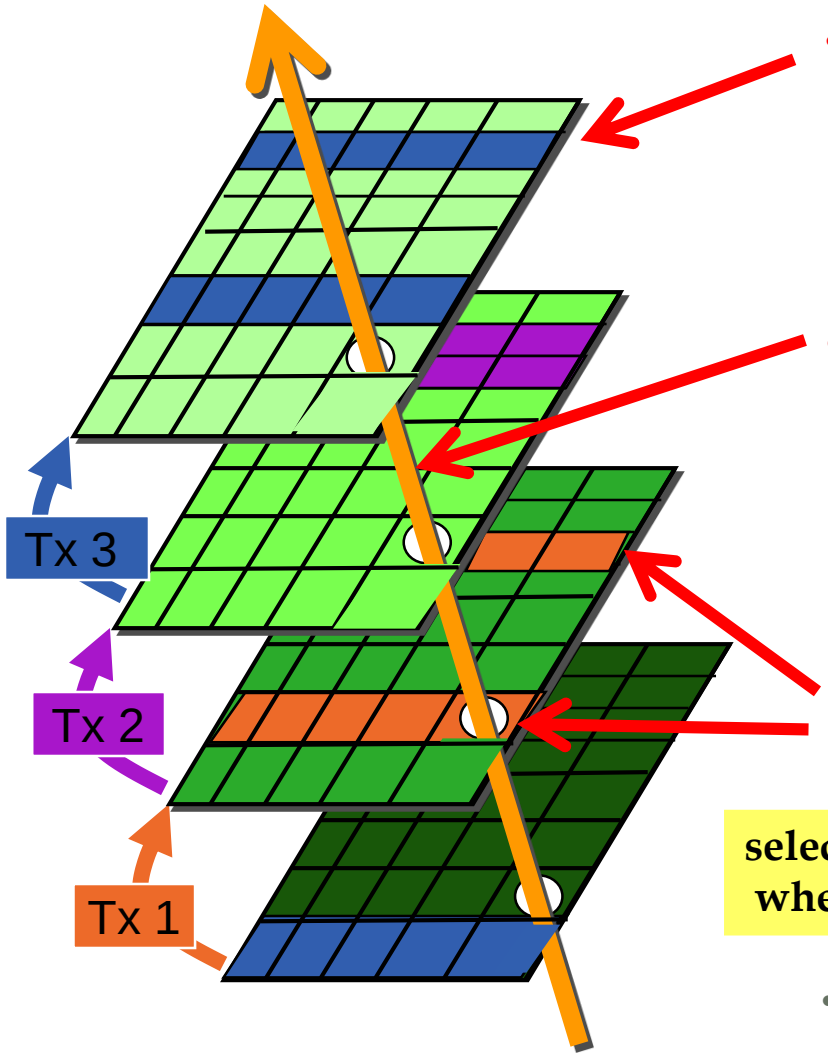


- Flashback revolutionizes error recovery
  - View 'good' data as of a past point-in-time
  - Simply rewind data changes
  - Time to correct error equals time to make error

Correction Time = Error Time + ~~f(DB_SIZE)~~

- Low impact
- Excellent tool for configuring QA, Dev and Training databases
- Flashback is easy – simple commands, no complex procedure

Error Investigation with Flashback



- **Flashback Query**
  - Query all data at point in time

```
select * from Salary AS OF '12:00 P.M.' where …
```

- **Flashback Version Query**
  - See all versions of a row between times
  - See transactions that changed the row

```
select * from Salary VERSIONS BETWEEN
 '12:00 PM' and '2:00 PM' where …
```

- **Flashback Transaction Query**
  - See all changes made by a transaction

```
select * from FLASHBACK_TRANSACTION_QUERY
 where xid = HEXTORAW('0002000300000002D');
```

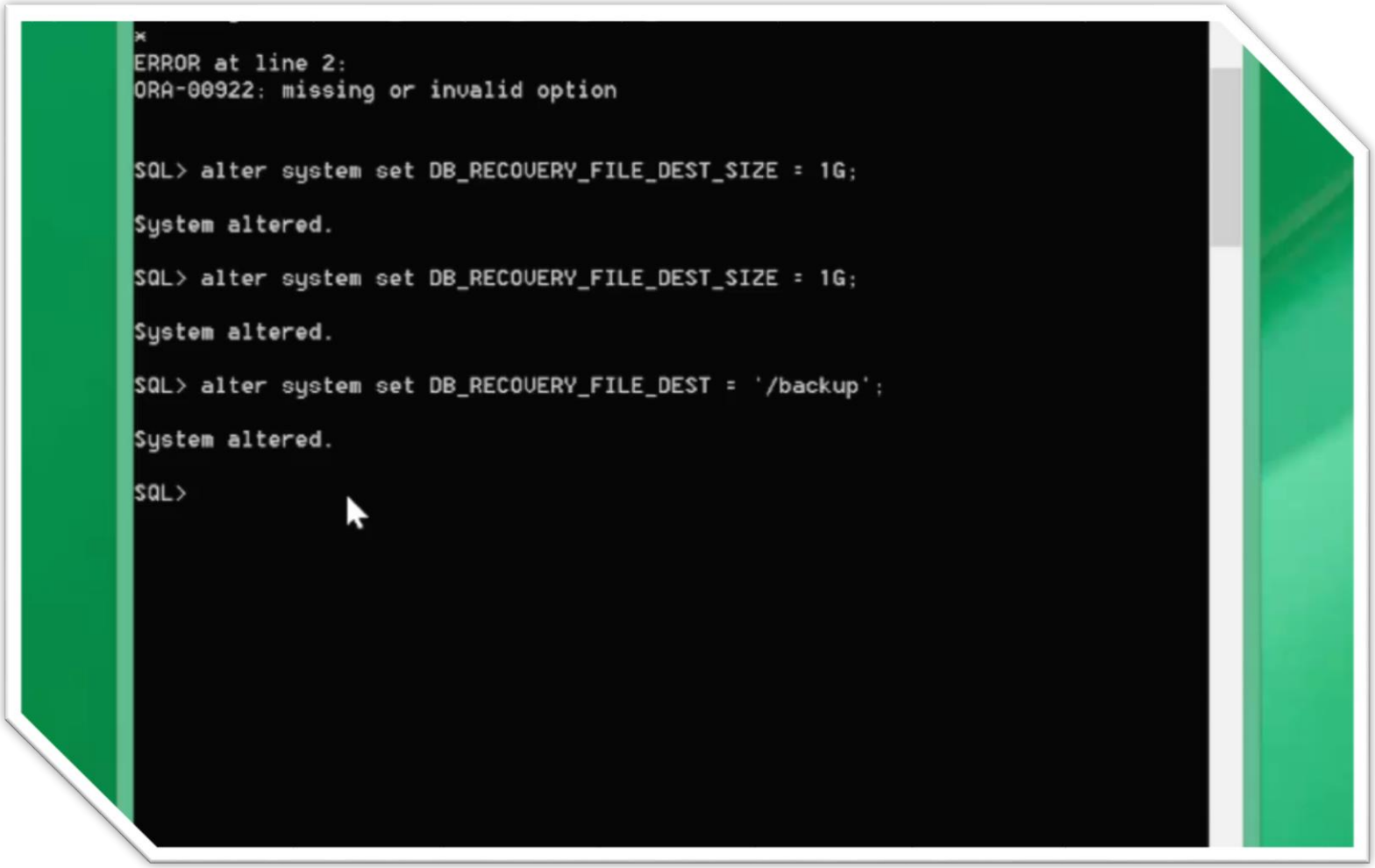
- **All above are based on available UNDO**

Rewinding a Database with Flashback Database

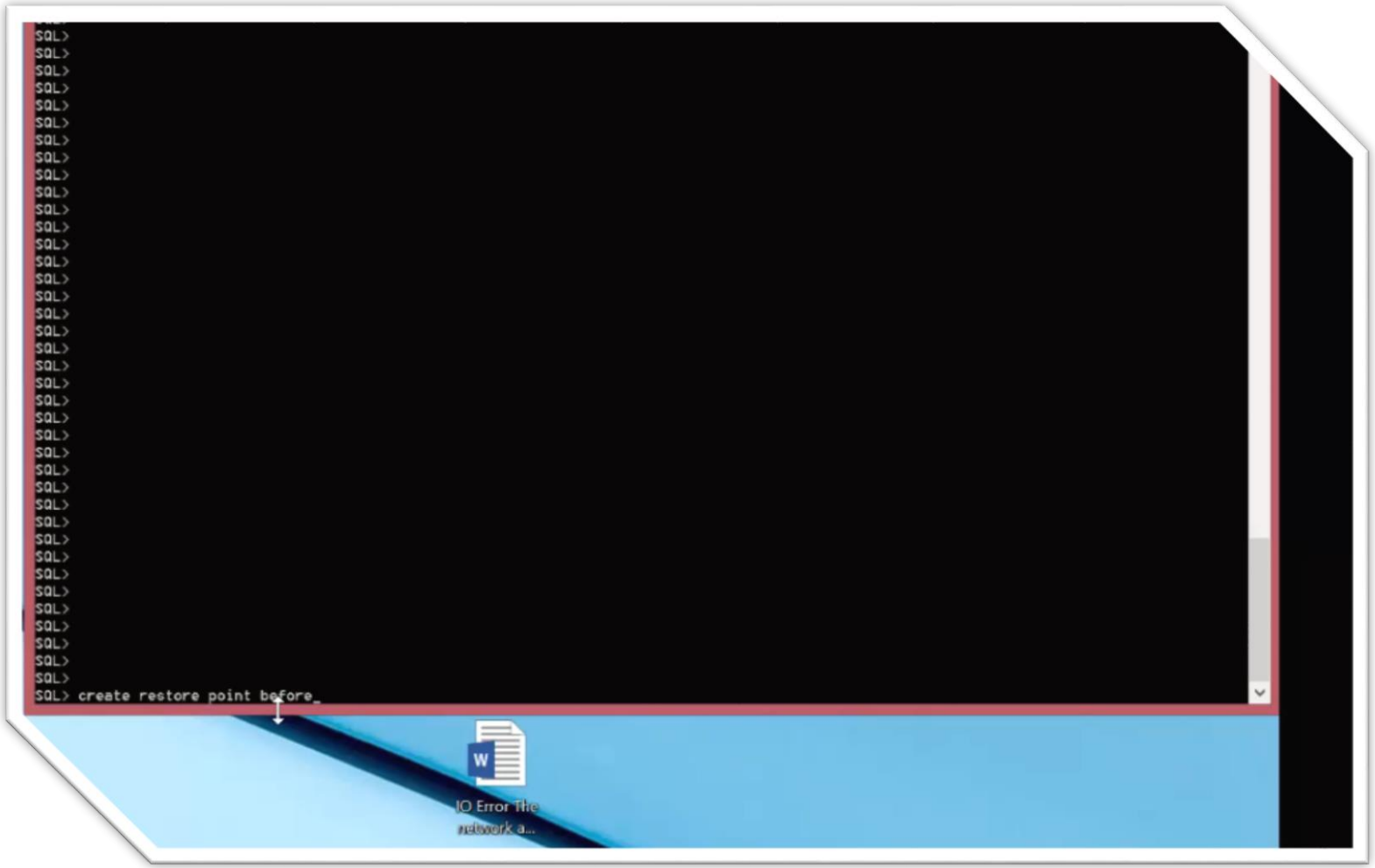
- You can use the Oracle Flashback Database to rewind the whole database to a past time.
- Unlike media recovery, you do not need to restore data files to return the database to a past state.

- To use the RMAN FLASHBACK DATABASE command,
- Your database must have been previously configured to generate flashback logs.

Rewinding a Database with Flashback Database



Using Normal and Guaranteed Restore Points



Flashback Example

le has one version of one row

name into the emp table.

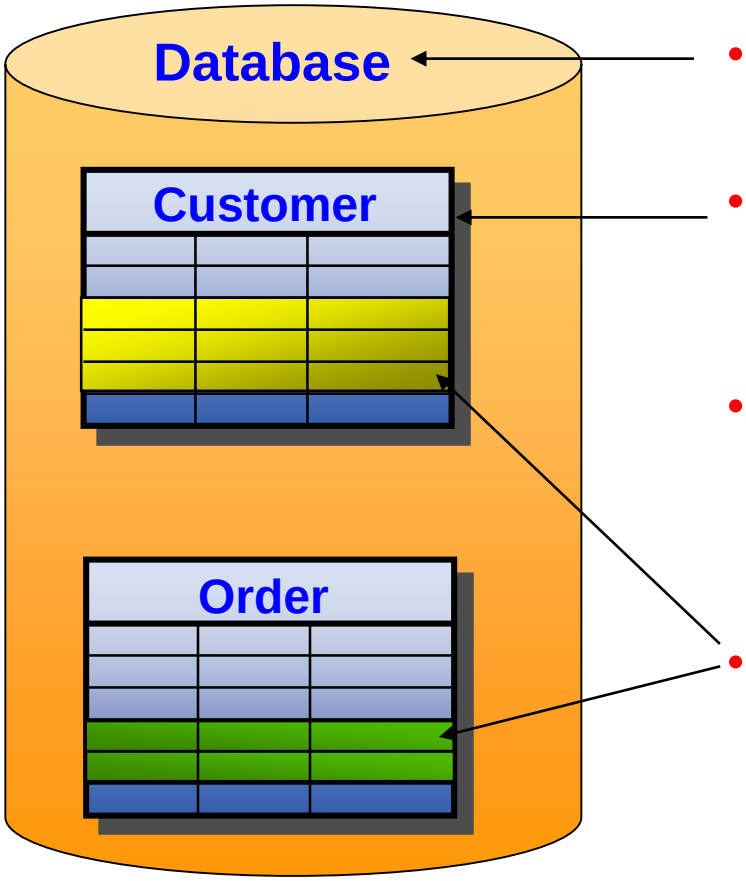
blem. The DBA issues the f

m table

pond to

```
XID              START_SAD COMMIT_SAD OP_SAD
---------------- --------- --------- ------------------------------
USER_SAD
------------------------------
UNDO_SAD
--------------------------------------------------------------------------------
060019009A030000    1249255    1249298 UNKNOWN
SYS

060019009A030000    1249255    1249298 UNKNOWN
SYS

XID              START_SAD COMMIT_SAD OP_SAD
---------------- --------- --------- ------------------------------
USER_SAD
------------------------------
UNDO_SAD
--------------------------------------------------------------------------------

060019009A030000    1249255    1249298 UNKNOWN
SYS

060019009A030000    1249255    1249298 UNKNOWN
SYS

XID              START_SAD COMMIT_SAD OP_SAD
---------------- --------- --------- ------------------------------
USER_SAD
------------------------------
UNDO_SAD
--------------------------------------------------------------------------------


060019009A030000    1249255    1249298 BEGIN
SYS


SQL> alter database add supplemental log data;

Database altered.

SQL> create table employe (empno number primary key,empname varchar2(16),salary number);
```

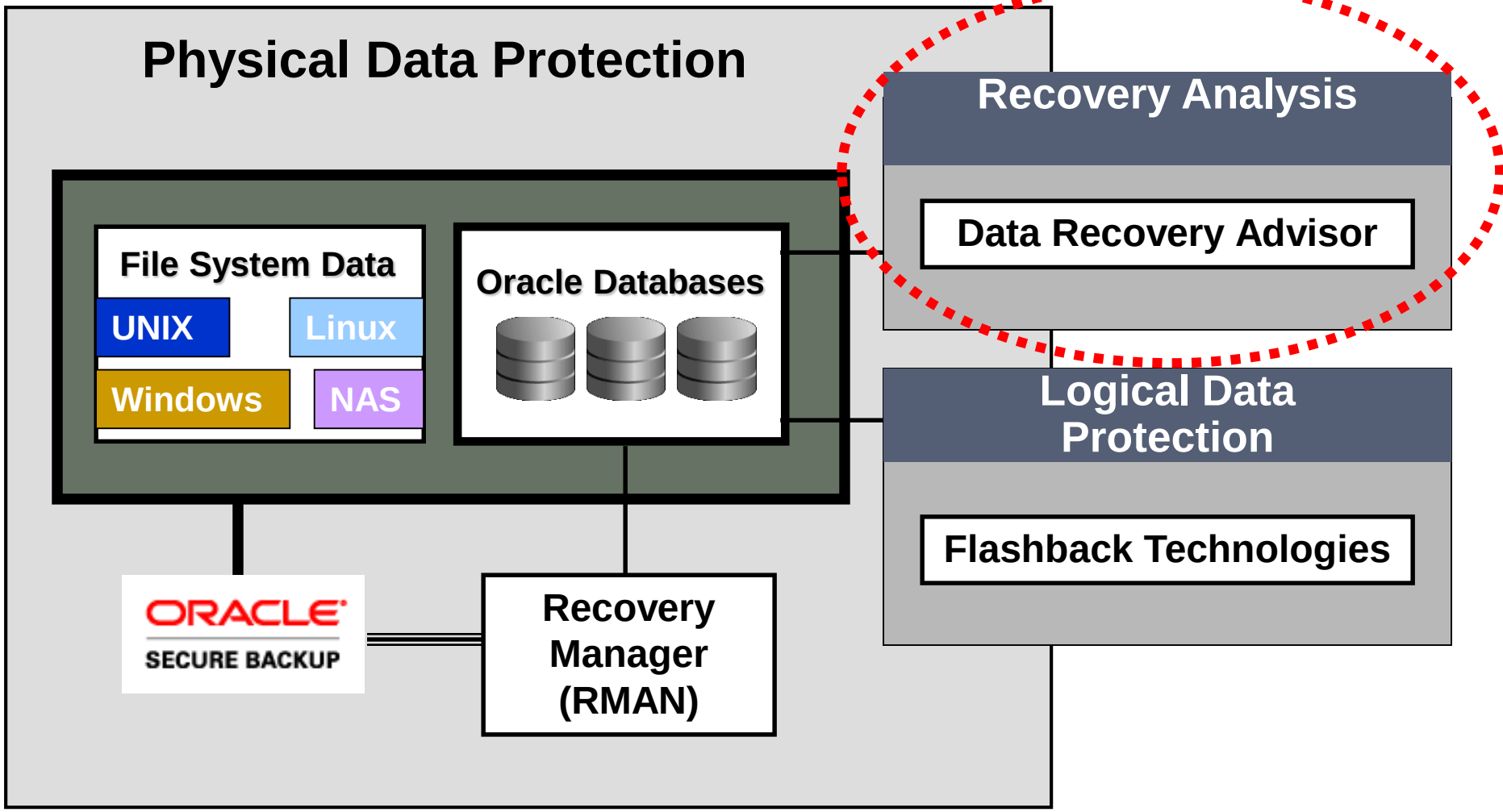
Error Correction with Flashback



- **Flashback Database** – restore database to any point in time
- **Flashback Table** – restore contents of tables to any point in time (undo-based)
- **Flashback Drop** – restore accidentally dropped tables (based on free space in tablespace)
- **Flashback Transaction** – back out transaction and all subsequent conflicting transactions (redo-based)

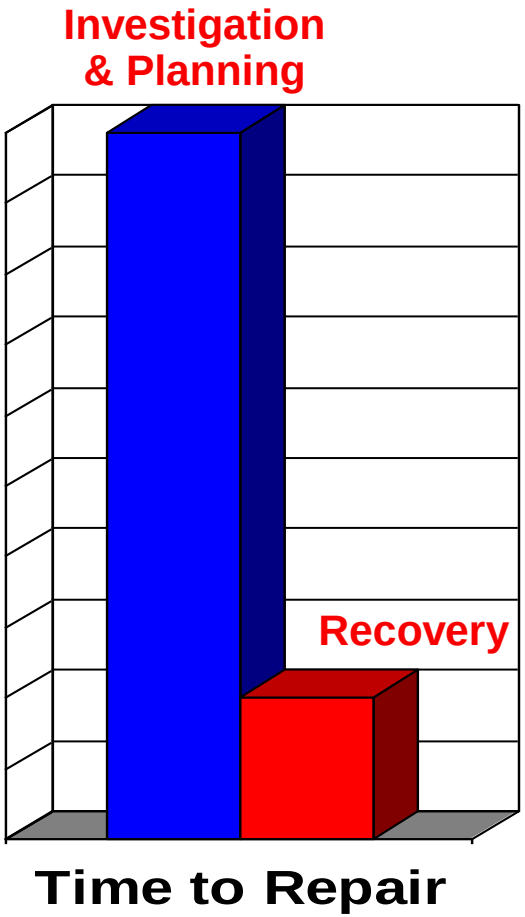
Recovery Analysis

Intelligent, Guided Recovery



Data Recovery Advisor

The Motivation



- Oracle provides robust tools for data repair:
  - ✓ RMAN – physical media loss or corruptions
  - ✓ Flashback – logical errors
  - ✓ Data Guard – physical problems
- However, problem diagnosis and choosing the right solution can be error prone and time consuming
  - Errors more likely during emergencies

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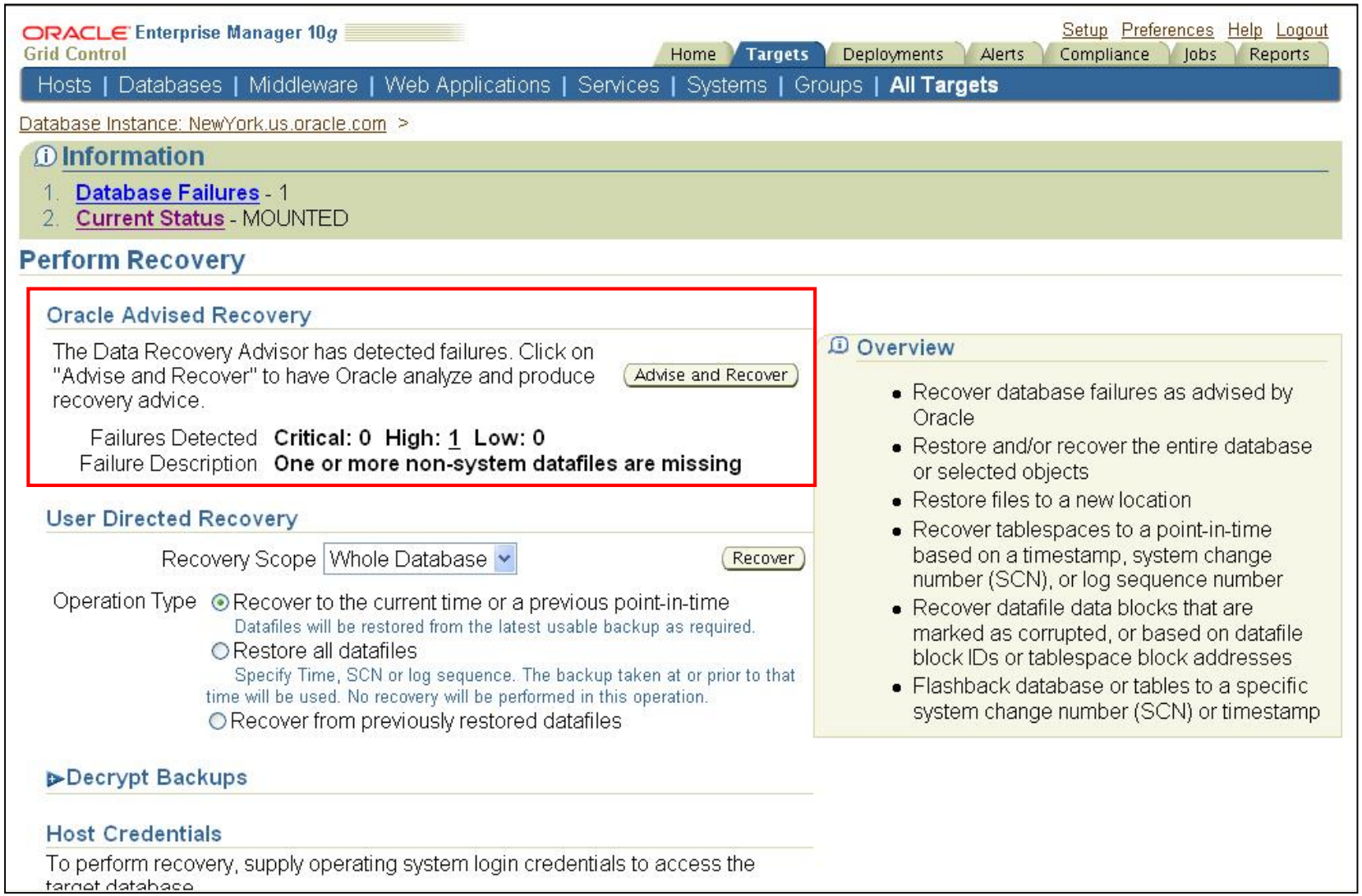
Data Recovery Advisor (DRA)

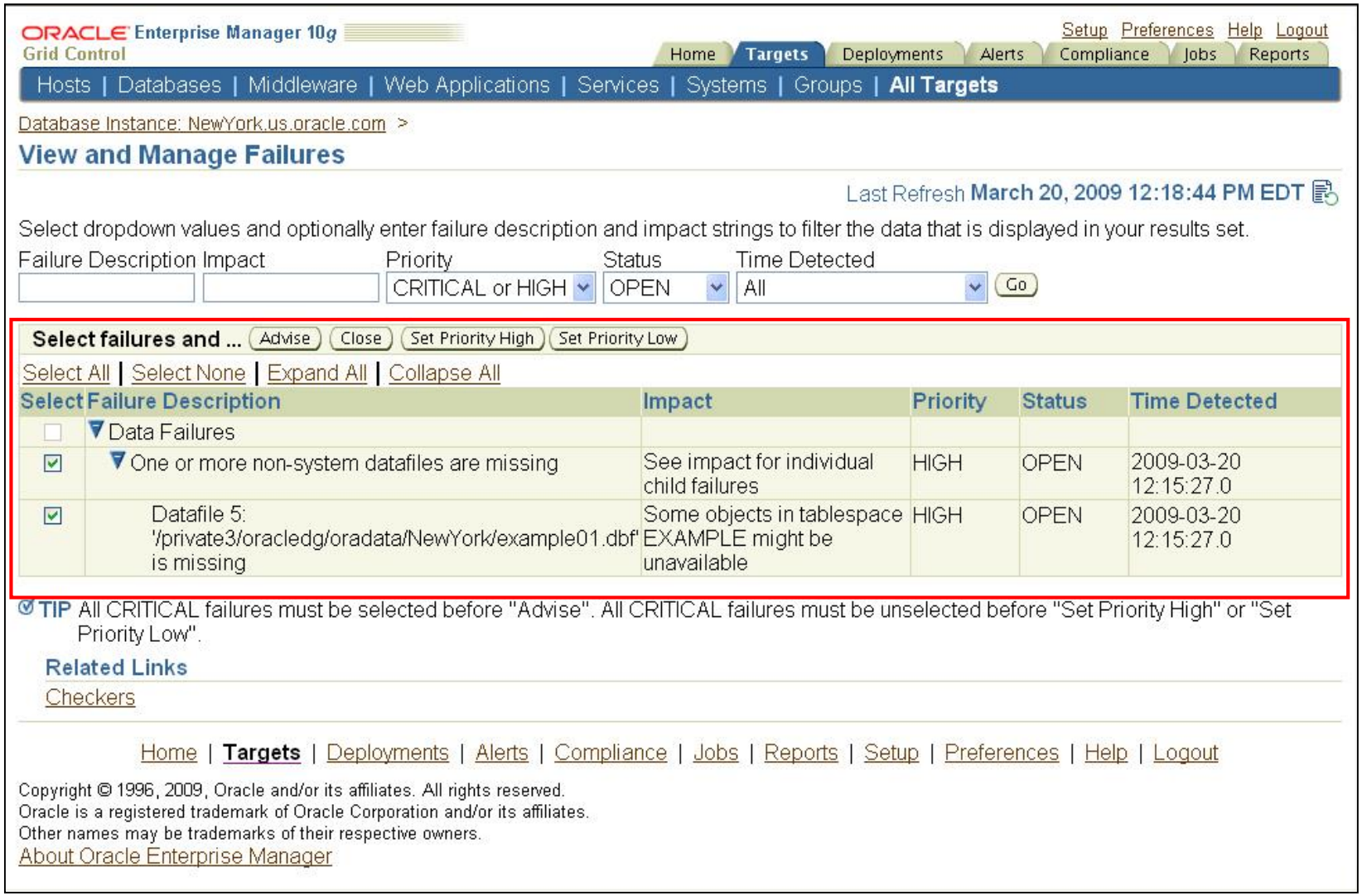
- Oracle Database tool that automatically diagnoses data failures, presents repair options, and executes repairs at the user's request
- Determines failures based on symptoms
  - E.g. an “open failed” because datafiles f045.dbf and f003.dbf are missing
  - Failure Information recorded in diagnostic Automatic Diagnostic Repository (ADR)
  - Flags problems before user discovers them, via automated health monitoring
- Intelligently determines recovery strategies
  - Aggregates failures for efficient recovery
  - Presents only feasible recovery options
  - Indicates any data loss for each option
- Can automatically perform selected recovery steps
- Accessed via RMAN or EM

Reduces downtime by eliminating confusion

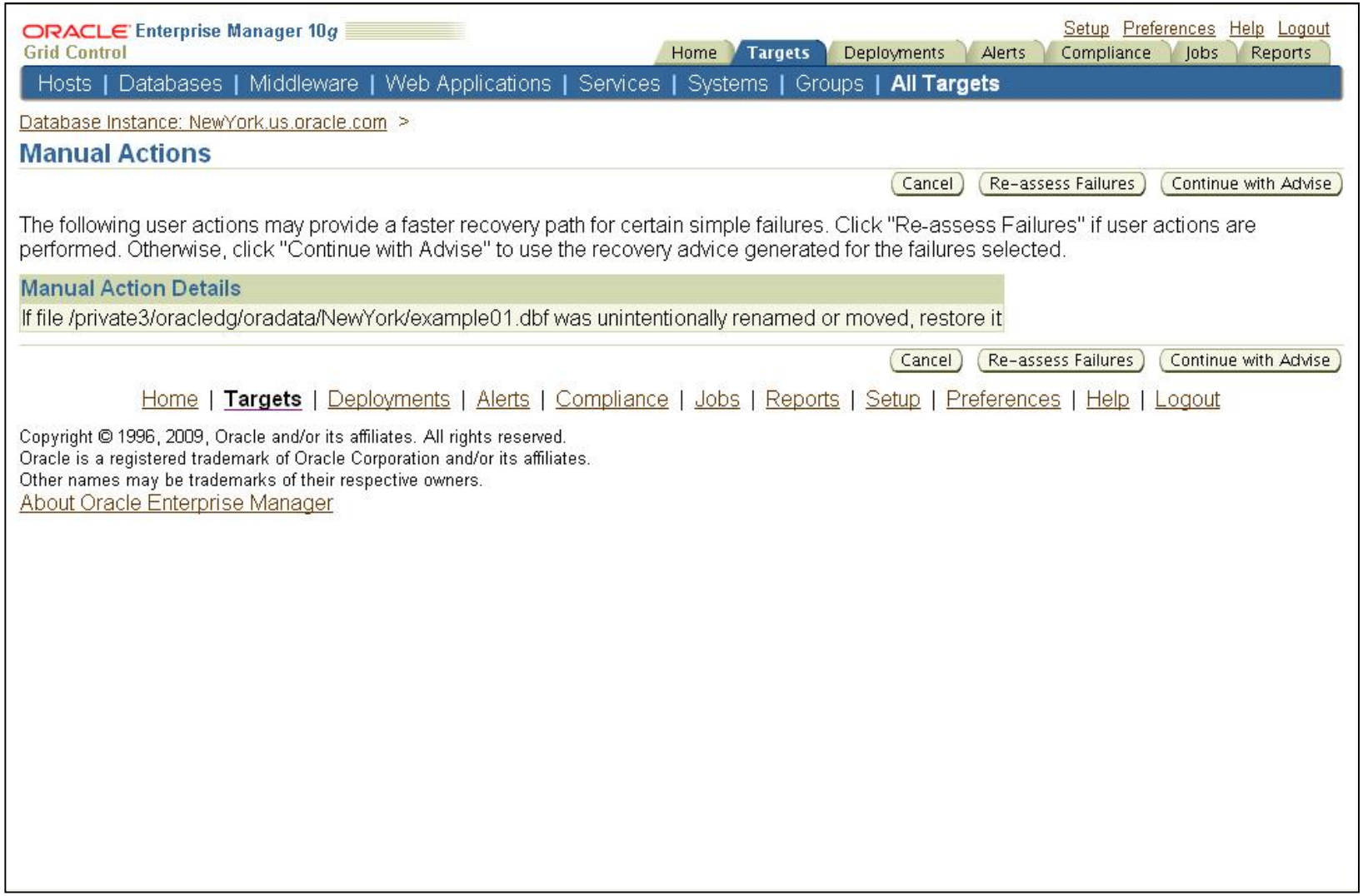
Data Recovery Advisor Wizard



Data Recovery Advisor – View Failures



Data Recovery Advisor – Manual Repair



Thanks,

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